3.0 ALTERNATIVES

This section describes the management alternatives being evaluated in the RP/EIS. Since this is a programmatic EIS, the alternatives reflect general approaches to the restoration of resources and services injured as a result of releases of hazardous substances and discharges of oil in the Commencement Bay environment. The five alternatives being evaluated in this EIS are: (1) No Action, (2) Species-Specific, (3) Habitat Function, (4) Acquisition of Equivalent Natural Resources and Services, and (5) Integrated Approach. The analysis in this draft EIS applies to the alternatives and the variation in types of actions that could be utilized to achieve restoration, but does not consider individual site-specific actions. Appropriate project-specific environmental analysis will be conducted for all future restoration activities in accordance with NEPA and SEPA.

3.1 Program Elements Common to all Alternatives

Unlike a more typical alternative analysis where many, most or all alternative features are often mutually exclusive (i.e., new highway routings), here there are numerous elements common to all options. This section strives to explain these common elements so the evaluation can highlight the differences among the alternatives, thereby focusing the choice.

3.1.1 Landscape ecology approach

For injured species and services restoration to succeed, comprehensive restoration planning must consider the landscape. The landscape perspective is critical to planning the distribution, composition, and character of habitat restoration opportunities. This ensures that injured resources and services derive maximum benefit from the limited funds available for restoration.

Most organisms live in islands of suitable habitat, among which there is an exchange of individuals, embedded in a larger landscape. Because the populations in the various habitat patches are linked by the movement of dispersing individuals, the fate of the populations is interconnected. The whole set of populations of a species that are linked through migration in a habitat mosaic is known as a metapopulation (Ecological Society of America, 1995), and the long-term survival of metapopulations is strongly affected by the spatial and temporal distribution of suitable and unsuitable habitat patches. Thus, without considering the linkages between habitats at the landscape scale, it is difficult to predict what the environmental consequences of restoring one particular habitat may be to the adjoining habitats and their fish and wildlife assemblages.

Landscape ecology involves an analysis of how various components (e.g., habitats) within a landscape interact in terms of the exchange of energy, materials and animals. This analysis provides information on the extent to which various components of the landscape will be utilized by different species. The landscape ecology principles of habitat location, size, shape, structure, accessibility, and resources and services are of particular relevance to restoration planning. From a restoration planning perspective, principles of landscape ecology provide a method for siting habitat restoration projects so that they are linked to existing viable natural habitats, and become functionally and structurally integrated into the Basin. The principles of landscape ecology can be utilized within various scales depending upon project goals. See Appendix C for a more detailed description of the use of landscape ecology.

A note of caution should also be included: it is understood that Commencement Bay will never be restored to its historic pristine condition; that is not the intent of the NRDA restoration plan. But there is a recognition that the sustainable functional elements of a healthy ecosystem can reside within an industrialized urban estuary.

3.1.2 Priority given to projects that benefit multiple species and services

Preference is given to projects that benefit multiple species over those that benefit a single species. However, effective projects for restoring individual natural resources and services will also be considered. This approach will maximize benefits to injured natural resources and services, as well as the ecosystem.

3.1.3 Sufficient connection to the injured natural resource or service

The expenditure of natural resource settlement funds requires a sufficient connection to the injured natural resource or service. Section 1.2.2 lists several factors that may compel the Trustees to look beyond the primary study area for potential restoration sites.

3.1.4 Utilize cost-sharing opportunities

For example, the John Day acid spill natural resource damage settlement, in Oregon, significantly expanded the number of restoration projects that might otherwise have been implemented by actively seeking matching funds. The consent decree established a $275,000 Trust Fund for use on restoration projects; this was increased to over one million dollars in actual project funding through cost sharing with The Nature Conservancy, Bonneville Power Administration, Oregon Department of Fish and Wildlife, Grant County Soil and Water Conservation District and the U.S. Forest Service (USDOI et al., 1994). Cost-sharing opportunities will be evaluated based on the types of NRDA settlements, available co-sponsors, benefits to injured resources and other factors, on a case-by-case basis.

3.1.5 Public participation

Individual projects will involve the affected and knowledgeable public in planning, design, implementation and long-term stewardship. The natural resource trustees have emphasized their commitment to involve the public, wherever practicable, in all phases of restoration activities.

3.2 Restoration Concepts Evaluated During Scoping

During the informal scoping meetings for the RP/EIS, eight initial restoration concepts or "ideas" were presented to the public to stimulate discussion. The eight original concepts were: No Action, Deferred Action, Incremental Restoration, Landscape Ecology, Habitat Protection, Species-specific, Supplement Existing Programs, and Prevention. These approaches and others were identified and discussed during scoping meetings, and/or were described in written comments. The Trustees screened these approaches to determine which would be appropriate for evaluation in the RP/EIS. The Trustees selected alternatives which: (1) could meet the stated purpose and need of the CB/NRDA restoration; (2) could provide predictable ecological change; (3) could be acceptable to the public, and/or agencies and tribes that commented during scoping; (4) would comply with applicable laws; (5) had features that were comparable between alternatives; and (6) could be evaluated for their environmental effects on a programmatic level.

The No Action and Species-Specific concepts were carried forward as alternatives for analysis in the EIS. Components of other concepts were evaluated along with scoping comments, and resulted in development of three additional alternatives: Habitat Function, Acquisition of Equivalent Resources and Services, and an Integrated Approach. The Scoping Document includes further detail and explanation of exclusions.

3.3 Alternatives Evaluated in the RP/EIS

3.3.1 Alternative 1: No Action

The "No Action" Alternative, required by NEPA, consists of expected conditions under current programs and regulations pursued by tribes and agencies outside the NRDA process. It is the baseline against which other actions can be compared. Section 5.0 describes other area programs and activities which would continue in the absence of CB/NRDA activities. If this alternative were implemented, the Trustees would not undertake any CB/NRDA restoration projects (USFWS and NOAA, 1995).

A consequence of the No Action Alternative is that some sites that might be considered for restoration purposes under the Restoration Plan might be developed for industrial, commercial or other non-habitat purposes if NRDA restoration projects were not implemented. For purposes of analysis in this EIS, it is assumed that lands put to such uses could result in adverse impacts to the injured natural resources and services being analyzed. An additional consequence of the No Action Alternative is the increased opportunity, regardless of development, for additional adverse effects on the fish, wildlife, sediment and water as a result of not restoring, replacing, rehabilitating or acquiring the equivalent of the injured natural resources and services in the interim until complete remediation and source control have occurred.

Typical actions under Alternative 1:

- sediment remediation by the EPA
- source control by Ecology
- non-NRDA habitat restoration programs
- hatchery programs by the State and Indian Tribes
- natural recovery of natural resources injured by contamination

3.3.2 Alternative 2: Species-Specific Restoration

This alternative focuses on a specific species or a group of species injured from the release of hazardous substances and discharge of oil, as identified in the CB/NRDA process, rather than on the restoration of generic habitat units and patches. Focal species could be ecological keystone species or economically or socially valuable species which have been injured. Species-specific restoration would be considered in situations where (1) most species will recover naturally after contaminant removal and implementation of source control, but where additional activities are required to assure the restoration of specific species; (2) an injured resource is unable to recover as a part of a general habitat restoration program following site remediation and source control; and (3) the target species or natural resource plays such an important ecological role that species-specific restoration would produce significant benefits for other injured natural resources and services.

This alternative focuses on accelerating recovery of the natural resources and services most severely injured by the release of hazardous substances or discharges of oil. Under this alternative, human intervention (beyond source control and sediment remediation) is required to produce significant improvements of the injured species over unaided natural recovery. Restoration actions would be designed to increase the numbers and/or distribution of specific species or species groups which have been injured. Potential species groups that could benefit from this alternative are salmonids, demersal fish, shellfish, and waterfowl.

If a species population is severely reduced in abundance or is physically impaired in an area because of chemical contamination or loss of critical habitat, restoration of the habitat could result in recovery of the population. Restoration, followed by reintroduction of a minimum viable population of individuals to the area, could result in recovery of the population which has been injured in an area. Restoration must focus on those habitats that are critical to the survival of the population. For example, restoring salmonid spawning habitat has been effective in restoring some salmonid populations (Koski, 1992).

Artificial propagation of populations, with or without site remediation and habitat restoration, has been shown to maintain populations in aquatic systems. Another option is to enhance fitness of the population through selective breeding as part of artificial propagation; this has proven successful in maintaining or supplementing species that have been injured in an area. A combination of species-specific restoration methods such as site remediation, habitat restoration, reintroduction, artificial propagation, and selective breeding could be an effective restoration strategy.

Example

The Muckleshoot Indian Tribe's White River Hatchery, operated for White River spring chinook salmon, is an example of species-specific restoration. The hatchery is one element of the White River Spring Chinook recovery plan. Spring chinook escapement to the White River declined to a low of 50 fish in 1977. Artificial production efforts began in the late 1970s. The White River hatchery was constructed in the late 1980s. Since then, the spawning population has been steadily rising, and as of 1995 had reached 2,000 fish per year (South Puget Sound Spring Chinook Technical Committee, 1995).

Typical actions under Alternative 2:

- constructing net pens, hatcheries, or artificial incubators
- creating or enhancing feeding, rearing or spawning habitat (e.g., constructing off channel rearing ponds, enhancing mainstem rearing habitat, placing woody debris, placing spawning gravels, cleaning spawning gravels, removing barriers and obstructions, regulating streamflow, stabilizing and fencing streambanks, planting riparian vegetation, improving food production)
- constructing artificial reefs or other substrate enhancements for demersal fish
- seeding intertidal mudflats with clams or oysters, distributing shell hash to provide refuge habitat for juvenile crabs
- erecting nest boxes or perches, and creating or enhancing nesting, loafing, feeding and rearing habitats for waterfowl

Implementation

Under this alternative, the restoration plan would consist of one or more projects for a selected species or group of species. The projects would be based on the appropriate structural and functional components needed to meet the restoration goals for that species.

The decision matrix and evaluation criteria by which restoration projects would be evaluated and selected for this alternative are shown in Table 3.3-1. Actions that involved both examination of habitats critical to target species, and actions such as artificial propagation

Table 3.3-1. Decision Matrix for Evaluating Potential CB/NRDA Restoration Projects Relative to Criteria for the Species-Specific Restoration Alternative. For each criterion, a project will be ranked according to its ability to meet that criterion (1=high, 2=medium, 3=low).

Project	EVALUATION CRITERIA [a]											
	High Importance									Medium Importance		Low Importance
	Functional Support for Target Species	Removes or Improves Limiting Factors for Target Species	Control of Contam. Affecting Target Species	Target Species far removed from Environ. Disturbance	Project Site Accessible by Target Species	Project Design Maximizes Benefits to Target Species	Long-term Self-maintenance for Target Species	Project Site is Available	Benefit: Cost for Target Species	Ownership/ Management	Land Use Compatibility	Public Access

[a] Based on USFWS and NOAA (1995), Shreffler and Thom (1993), and Elliott Bay/Duwamish Restoration Program (1994).

and construction of physical structures (e.g., nest boxes), would be examined in terms of landscape considerations. As outlined below, the criteria are grouped into categories of high, medium and low importance.

High importance

1. Functional support for target species: project will provide functional benefits to one or several specific target species that were injured: restoration efforts may include habitat, enhancement of selected attributes, or artificial propagation.

2. Project removes or improves limiting factor(s) for target species.

3. Contaminants affecting target species are controlled: an environmental audit or similar report could be conducted to demonstrate that the site has limited potential for recontamination.

4. Target species are removed from environmental disturbance: site is sufficiently separated from environmental disturbances (e.g., noise, light) or other stressors (e.g., sedimentation, erosion).

5. Project site is directly accessible by target species: site is located within an ecologically critical area of the estuary or basin for the target species and is well connected to existing or potential viable habitats, has adequate buffers, and direct access for target species.

6. Project design provides maximum benefit to target species: the project has the potential to benefit more than one aspect of the life history of the target species.

7. Project provides long-term, self-maintained support to target species: project will require less human intervention over time.

8. Project site is or can be made available for restoration of target species.

9. Benefit to target species is high, relative to the cost of the project: site can be restored and maintained for the target species more cost-effectively than other sites, while providing the same level of benefits.

Medium importance

10. Ownership/management promotes target species restoration sooner and in perpetuity.

11. Land use compatibility: site avoids conflicts with existing or planned land uses or designations; neither existing nor planned land use is likely to disturb target species.

Low importance

12. Sites would accommodate non-intrusive (e.g., minimal disturbance to fish and wildlife) public access.

3.3.3 Alternative 3: Habitat Function Restoration

This alternative involves actions designed primarily to benefit certain habitat types that support a range of species. It assumes that if functional habitat is created, use by injured species would follow, and injured species and services would be restored. It further assumes that more diverse habitat would yield a greater diversity of biota. The goal of this alternative is (1) to restore habitats that provide functional benefits (e.g., feeding, refuge, reproduction) to multiple natural resources and services injured as a result of the release of hazardous substances or discharges of oil, or (2) to purchase and enhance existing functional habitats that would provide direct benefits to injured natural resources and services.

The Conceptual Restoration Plan (Volume II), and the affected environment section (Volume I, section 2) identify a number of habitat types within the Commencement Bay study area, along with assemblages of organisms supported by those habitat types. The assemblages of organisms that these habitat types probably support is based on the Estuarine Habitat Assessment Protocol (EHAP) (Simenstad et al., 1991)(see Appendix D). Many of the species identified in the EHAP assemblages are those that have been potentially injured as a result of the release of hazardous substances and discharge of oil in Commencement Bay.

Shreffler and Thom (1993) illustrated that the EHAP can be used to determine the predicted number of species to be gained as additional estuarine habitats are restored or created. For example, a restored emergent marsh alone is predicted to support 38 species; including an adjacent mudflat should predictably add six more species, and integrating a gravel patch is predicted to add 21 species. The EHAP is based on the assumption that, if habitats are enhanced, constructed, or restored, specific species will benefit from using the habitats. However, this assumption can only be met if: (1) an adequate local pool of species exists (i.e., minimum viable population), (2) corridors of access are suitable, (3) water and sediment quality does not impair habitat use, (4) adequate buffers exist, (5) habitats are of sufficient size to support the species, (6) habitats are sufficiently stable over time to benefit the species, and (7) habitat mixtures are appropriate to the hydrogeomorphology at the site and will be self-maintained.

<u>Example</u>

The St. Paul Cap is an example of habitat function restoration. The St. Paul Waterway was one of the problem areas identified in the CBN/T (EPA, 1989). The potentially responsible parties entered into a consent decree with Ecology in 1987 to remedy the sediment contamination, and in 1991 they entered into a federal settlement to address additional remediation and monitoring required by EPA's ROD and to resolve their CB/NRDA claims in the waterway. The remedy involved placing a sediment "cap" over the contaminated areas and relocating the outfall. The settlement also included a restoration program to create intertidal habitat. In 1988, 300,000 cubic yards of clean sediment were dredged from the Puyallup River and placed on top of the contaminated sediments. Instead of leaving the bottom smooth and flat, pools and ridges were constructed, creating a more diverse habitat. Large rocks were scattered over areas to provide a place for algae to take hold. About 6 acres of intertidal habitat was constructed along the shoreline and shallow water habitat was created over the remaining 11 acres. The newly created intertidal habitat supports over 200 species of worms, crabs, and other small crustaceans. The area provides a feeding and refuge area for juvenile salmon and trout, other marine fish and shorebirds (Parametrix, 1993 and 1994).

Typical actions under Alternative 3:

- creating or restoring intertidal beaches with fringing salt marshes by either filling deep subtidal habitats or excavating upland areas
- breaching river dikes to return tidal or riverine waters to former wetlands and riparian habitats
- excavating uplands to create palustrine wetlands
- returning natural hydrology to agricultural lands that were formerly wetlands
- enhancing vegetated buffers
- transplanting eelgrass
- removing impediments of river flow to return a river to a more natural channel
- reconnecting oxbows

Implementation

Implicit in this plan are the concepts of landscape ecology. Restoration activities under this alternative would focus on how land types (existing, enhanced or created) and their supporting services can best be utilized within the ecosystem to benefit natural resources and services that have been identified in the CB/NRDA process as injured.

Within this context, existing habitat types such as vegetated shallows, mudflats, sloughs, marshes, rivers, creeks, and their associated riparian areas would be evaluated as to how they may best function together. This approach recognizes the importance of optimizing the connection between the estuary and the Basin, and between the rivers and the Bay, by reestablishing corridors. Demonstrable accomplishments such as increasing the amount of edge of preferred habitat types or a notable increase in the areal extent of specific habitats, such as mudflats, marshes and sloughs, would be a tangible demonstration of this alternative. A diversity of self-sustaining habitat would result from overall implementation of this alternative, but would not necessarily result from implementation of each individual project.

Many of the restoration projects would occur in the area shown as the primary study area in Figure 1.1-3, where most of the injuries have occurred. Projects may be located in the expanded study area, shown in Figure 1.1-4, when restoration actions can best meet the overall needs of injured resources (either economically or ecologically), or to ensure that restoration actions benefit injured natural resources and services throughout their geographical range. The decision matrix and evaluation criteria by which restoration projects would be evaluated and selected for this alternative are shown in Table 3.3-2 and described below.

High importance

1. Functional connectivity: site has functional connectivity with existing or potential habitat sites (e.g., are contiguous to other habitats; can become part of an existing or potential wildlife corridor).

2. Location: site is located in an ecologically critical area of the estuary or basin (i.e., sites that are necessary for increasing populations of selected species).

3. Separation from sources of contaminants or environmental disturbances (e.g., noise or light): site is sufficiently separated from such sources so as not to cause a long-term problem for fish and wildlife.

4. Cost-effectiveness: site may be restored and maintained more cost-effectively than other sites, such as sites that allow for enhancement of existing, rather than creation of new habitat, and require less change (excavation, engineering, etc.) and maintenance.

5. Sustainability: project will require less human intervention over time. Attributes impacting the likelihood of success include elevation, currents/deposition, wave energy, topography and shoreline condition.

Medium importance

6. Size: site has sufficient restorable habitat area to form larger areas of contiguous habitat. Larger sites have better capability of supporting more resources.

7. Ownership/management promotes restoration sooner and in perpetuity.

Table 3.3-2. Decision Matrix for Evaluating Potential CB/NRDA Restoration Projects Relative to Criteria for the Habitat Function Restoration Alternative. For each criterion, a project will be ranked according to its ability to meet that criterion (1=high, 2=medium, 3=low).

Project	EVALUATION CRITERIA [a]										
	High Importance					Medium Importance				Low Importance
	Functional Connectivity with existing or potential habitat sites	Location in ecologically critical area of estuary or Basin	Cost-effective	Separation from Contam. or environmental disturbance	Sustainability	Size	Ownership/ Management	Land Use Compatibility	Water quantity and flow	Public Access

[a] Based on Commencement Bay Natural Resources Damage Assessment 'Restoration' Panel (1995), and Elliott Bay/Duwamish Restoration Program (1994)

8. Land Use Compatibility: nature and condition of existing surrounding land use as well as future concerns such as shoreline designation, zoning, comprehensive or project-specific planning.

9. Water quantity and flow (this is specific to freshwater stream and riparian sites): site would resist seasonal flooding impacts and streambank erosion.

Low importance

10. Sites would accommodate nonintrusive (e.g., minimal disturbance to fish and wildlife) public access.

3.3.4 Alternative 4: Acquisition of Equivalent Natural Resources and Services

Under this alternative, projects, and activities would focus on the acquisition of equivalent natural resources and services which would be the same or substantially similar to the natural resource or service that was injured but which could not otherwise be restored. Substantially similar resources or services are those which ensure that the resources or services provided after the release of hazardous substances or discharges of oil are as close as possible to the resource and service conditions that would have existed if the release or discharge had not occurred.

Acquisition of equivalent natural resources and services should be considered in those cases where, in the judgement of the Trustees, restoration is technically infeasible or the cost is too prohibitive. Acquisition of equivalent resources and services should also be considered when the time frame for restoration utilizing other alternatives would be of such length that the public would suffer continuing loss.

Equivalent natural resources should be acquired, preferably in proximity to the affected area, to enhance the recovery, productivity, or survival of the ecosystem affected by the release of hazardous substances or discharges of oil. One focus of this alternative is the reintroduction or enhancement of resources that benefit people within the Bay and Basin. Since the natural resources and services that were either lost or injured benefitted people as well as the ecosystem, enhancement of other valuable resource species is an approach for compensating for those losses. The alternate species, because of their presence in the degraded system, may have greater ease of enhancement than those species severely and directly injured. Those resources that are enhanced would include species that may still exist in the area, but are limited by habitat availability or some other factor that can be manipulated to improve conditions.

Services affected in Commencement Bay include recreational, commercial, ecological, cultural, and other activities. Recreational services include recreational boating, fishing, and wildlife viewing, while commercial services include navigation, harvest, and water use. Typical ecological services include biological diversity, habitat protection, food chain to ensure that restoration actions benefit injured natural resources or services throughout their geographical range.

The decision matrix and evaluation criteria by which restoration projects would be evaluated and selected for this alternative are shown in Table 3.3-3 and described below. The criteria are grouped into categories of high, medium and low importance.

High importance

1. Equivalent natural resources or services can be acquired in proximity to the affected area: site located within an ecologically critical area of the estuary or basin and is well connected to existing or potential habitats, has adequate buffers and direct access for equivalent natural resources and services.

2. Functional support for equivalent natural resources and services is maximized: the project contains key habitats or actions that are linked to, replace, provide the equivalent of, or substitute for injured natural resources or services.

3. Similarity between the acquired natural resources and services to those that were injured (e.g., ecological, social, economic, cultural) is maximized.

4. Potential for adverse impacts (e.g., predation, competition, genetic interaction) of substituted resources upon existing natural resources of concern is minimized.

5. Site is separated from contamination sources: including chemical contaminants, environmental disturbances, or other stressors.

6. Site has essential attributes for equivalent natural resources or services: essential attributes include areas for feeding, refuge, reproduction, molting, roosting and migration.

7. Long-term self-maintenance of functioning for equivalent natural resources or services: site will require less human intervention over time.

Medium importance

8. Ownership/management promotes restoration or preservation sooner and in perpetuity.

9. Land use compatibility: adjacent land uses will not significantly degrade the ecological function of the essential habitats or projects selected for acquisition of equivalent natural resources or services.

support, and waterfowl nesting sites. Cultural services include subsistence and ceremonial practices. Other services could include research, education, and aesthetics.

Example

The Puyallup Tribe's Clark's Creek fish hatchery is an example of acquiring the equivalent of spawning and rearing habitat by artificially spawning fish, incubating eggs, and providing rearing ponds to grow fish prior to release back into the natural system.

Typical actions under Alternative 4:

- acquiring replacement or substitute property or services
- constructing artificial reefs or substrate enhancements to provide equivalent habitat functions for rockfish
- constructing aquaculture facilities, propagating shellfish for stocking in suitable areas
- reintroducing or enhancing alternate species, stocking of fish species
- creating habitats away from known discharge sites to provide equivalent services for fish and wildlife production
- constructing hatcheries and net pens to provide equivalent habitat functions
- improving operations of existing salmon hatcheries to improve the quality of fish (e.g., constructing better acclimation ponds and early rearing ponds, changing the timing of release of hatchery fry or smolts to reduce potential interaction with natural fry) and thereby providing equivalent habitat functions
- direct feeding of waterfowl to provide an equivalent food source
- creating public access/viewing areas

Implementation

The damage assessment process would be used to define injured natural resources and services. This alternative would be implemented in situations where restoration is technically infeasible, the cost is too prohibitive, or other restoration via other alternatives would be of such length that the public would suffer continuing loss. An evaluation would be conducted to determine if a similar resource or service could benefit the people within the Bay and Basin. Projects would be located based on their ability to benefit the people within the Bay and Basin, provided they are removed from the effects of contamination, or

Low importance

10. Sites would accommodate nonintrusive (e.g., minimal disturbance to fish and wildlife) public access.

3.3.5 Alternative 5: Integrated Approach

The goal of this alternative is to maximize the opportunities for restoring, replacing, rehabilitating or acquiring natural resources and services injured as a result of the release of hazardous substances or discharges of oil, by integrating the best elements of three alternatives (habitat function, species-specific, and acquisition of equivalent resources and services).

As a comprehensive plan to restore injured species in the Bay and Basin, the integrated approach is based primarily on the habitat function alternative, which forms the core of the integrated approach, as well as specific components from the Species-Specific and Acquisition of Equivalent Natural Resources and Services Alternatives that would assist with (1) restoration of injured resources in the interim while habitat restoration is developing into a fully functioning system, and (2) recovery of those resources that require additional measures to achieve restoration.

Specific components from the Species-Specific Alternative could include:

- creating or enhancing feeding, rearing, or spawning habitat for selected fish and wildlife species that have been injured (e.g., removing barriers and obstructions, placing spawning gravel, stabilizing and fencing stream banks);
- modifying the substrate, at locations in the Bay where appropriate habitat and water quality conditions exist, to make it more conducive to shellfish and demersal fish needs, and possibly seeding for clams and oysters;
- seasonal delayed release salmon net pens; and
- erecting nest boxes or perches.

Specific components from the Acquisition of Equivalent Natural Resources and Services Alternative could include:

- purchasing property for preservation;
- facilitating cultural services such as subsistence and ceremonial practices;
- creating habitats away from known discharge sites to provide equivalent services within the region for fish and wildlife production;

Table 3.3-3. Decision Matrix for Evaluating Potential CB/NRDA Restoration Projects Relative to Criteria for the Acquisition of Equivalent Natural Resources and Services Alternative. For each criterion, a project will be ranked according to its ability to meet the criterion (1=high, 2=medium, 3=low).

	EVALUATION CRITERIA [a]									
	High Importance							Medium Importance		Low Importance
Project	Equivalent Resources/ Services can be Acquired in Proximity	Functional Support for Equivalent Resources/ Services	Similarity Between Acquired Resources and Services	Potential for Adverse Impacts Minimized	Site Separated from Contaminant Sources	Site has Essential Attributes for Equivalent Resources	Long-term Self-Maintenance of Functioning for Equivalent Resources	Ownership/ Management	Land Use Compatibility	Public Access

[a] Based on USFWS and NOAA (1995), Shreffler and Thom (1993), and Elliott Bay/Duwamish Restoration Program (1994).

- improving operations of existing salmon hatcheries to improve the quality of fish (e.g., creating off-channel rearing ponds in conjunction with existing hatcheries, changing the timing of release of hatchery fry or smolts to reduce potential interaction with wild fry) and thereby provide equivalent habitat functions; and

- creating public access/viewing areas.

Example

An example of how some of these components can come together and interact is the Gog-le-hi-te wetland mitigation project located on the Puyallup River. The Gog-le-hi-te project was created in an ecologically significant location within the Commencement Bay estuary. Some of the objectives included in the design were areas devoted to support of juvenile salmon. This was accomplished by providing off-channel access to fish and excavating uplands to create intertidal mudflats for feeding and refuge. Waterfowl were also accommodated in the design by creating a tidal marsh for feeding and nesting birds. A "buffer" of native trees and shrubs was planted around the site to minimize disturbances and to provide structural complexity (Shreffler et al., 1992).

Implementation

As with the Habitat Function Alternative, implicit in the Integrated Approach are the concepts of landscape ecology. Within this context, existing habitat types would be evaluated as to how they may best function together. This alternative provides opportunities for natural resources and services that would not recover without efforts above and beyond regulatory requirements for source control and sediment cleanup; or from other habitat restoration activities. The Integrated Approach Alternative provides opportunities for providing "upfront" benefits to injured species to compensate for slow ecological development of constructed habitats through use of technological solutions.

Many of the restoration projects would occur in the primary study area, shown in Figure 1.1-3, where most of the injuries have occurred. In some instances, where restoration actions could best meet the overall needs of injured resources (either economically or ecologically), or to ensure that restoration actions benefit injured resources and services throughout their geographical range, projects may be located in the expanded study area shown in Figure 1.1-4. The decision matrix and evaluation criteria by which restoration projects would be evaluated and selected for this alternative are the same as those utilized for the Habitat Function Alternative (Table 3.3-2).

The Integrated Approach further refines the location of restoration projects by the inclusion of habitat focus areas. While not all restoration activities need occur in these areas, recognition of their importance within the landscape provides the ecological rationale.

3.4 Alternatives Eliminated from Further Consideration

3.4.1 Introduction, goals, and criteria for evaluation

This subsection presents a preliminary screening of the five alternatives to natural resource and service restoration. The preliminary screening was performed using evaluation criteria developed to evaluate each alternative's ability to meet the identified purpose and need of the CB/NRDA restoration program. Alternatives determined to best meet the stated purpose and need, along with the No Action Alternative (required by CEQ's NEPA regulations, 40 CFR Part 1502.14(d)), will be evaluated in detail.

The Commencement Bay Restoration Panel developed the following goals and objective which the Trustees believe are comparable to those needs and objectives typically discussed in a NEPA document. Evaluation of the alternatives against the goals and objective listed below results in a systematic determination of which alternatives are best able to meet the purpose and need of the CB/NRDA restoration program. The three goals are to:

1. Meet the statutory objectives of restoring, replacing, rehabilitating and acquiring the equivalent of natural resources and services injured or destroyed as a result of the release of hazardous substances or discharges of oil.

2. Provide alternatives for those natural resources that will not recover without efforts above and beyond regulatory requirements for source control, sediment cleanup, and habitat restoration (e.g., certain fish and wildlife species, and water quality).

3. Provide a diversity of sustainable habitat types and species within the Commencement Bay ecosystem to enhance fish and wildlife resources.

The first objective is to:

> Provide a functioning and sustainable ecosystem where selected habitat and species of injured fish and wildlife will be enhanced to provide a net gain of habitat function beyond existing conditions.

To evaluate the ability of each of the five alternatives to meet these three primary goals and the objective, a decision matrix with six evaluation criteria was developed and is presented below. Criteria 1 captures the intent of restoration goal 3. Criteria 2 is a measure of goal 2. Because all the alternatives must first and foremost meet the statutory objectives, as outlined in restoration goal 1 above, a specific criteria to discriminate between the alternatives relative to this goal was not developed. Criteria 5 and 6 provide a measure of the first objective. Appendix E provides the detailed analysis of the five alternatives, including a narrative evaluation of each alternatives' ability to meet each of the six criteria. Table 3.4-1 provides a detailed summary of the evaluation.

Criteria 1: Potential for ecological benefits

Potential for direct and indirect ecological benefits to more than one injured natural resource and/or service: Will implementation of this alternative result in a net gain of habitat, injured natural resources, or resource services?

Criteria 2: Provides an alternative

Provides an alternative for those natural resources that will not recover without efforts above and beyond regulatory requirements for source control, sediment cleanup, and habitat restoration (e.g., certain fish and wildlife species, and water quality).

Criteria 3: Potential for environmental impacts

Will additional environmental impacts potentially result from this alternative? For this screening evaluation, impacts related to the central issues of habitat and biological resources, water quality, and sediment quality are considered.

Criteria 4: Cost effectiveness

Does this restoration alternative achieve the desired benefits in a cost effective manner considering direct and indirect environmental, social, and economic costs?

Criteria 5: Probability of success

Will implementation of this alternative result in restored habitats that are self-maintaining over the long-term? Does the data and/or literature support this restoration alternative? Are technology and management skills available to successfully implement this restoration alternative?

Criteria 6: Reduces fragmentation of landscape

Will this alternative reduce the present degree of fragmentation of the landscape by increasing habitat connectivity, buffers, and access for injured species?

3.4.2 Comparison of Alternatives

This section summarizes the assessment and comparison of the five alternatives according to the six evaluation criteria, and identifies the alternatives to be carried forward for detailed analysis. See Appendix E for a detailed evaluation of the five alternatives.

Table 3.4-1 Comparison of Alternatives

	ALTERNATIVES				
CRITERIA	1 NO ACTION	2 SPECIES-SPECIFIC	3 HABITAT FUNCTION	4 ACQUISITION OF EQUIVALENT	5 INTEGRATED APPROACH
3. Potential for environmental impacts.	**Low-Moderate**	**Moderate**	**Low-moderate**	**Moderate**	**Low-moderate**
Water Quality	**No adverse or beneficial impacts.**	**Construction: short-term impacts.**	**Construction: short-term impacts.**	**Construction: short-term impacts.**	**Construction: short-term impacts.**
		Potential long-term impacts from fishery/ aquaculture facilities by raising concentrations of nutrients, bacteria and chemicals (used to control disease).	**Long-term beneficial impacts resulting from increase in wetland area.**	**Potential long-term impacts from fishery/ aquaculture facilities by raising concentrations of nutrients, bacteria and chemicals (used to control disease).**	**Proper siting of seasonal net pens will eliminate long-term adverse impacts.** **Long-term beneficial impacts resulting from increase in wetland area.**
Sediment Quality	**No adverse or beneficial impacts**	**Short-term increases in sedimentation and turbidity from construction.** **Potential long-term impacts from fishery/ aquaculture facilities could result in long-term organic enrichment of bottom substrates.**	**Short-term increases in sedimentation and turbidity from construction.** **Long-term beneficial impacts from creation of new habitats resulting in clean substrata.**	**Short-term increases in sedimentation and turbidity from construction.** **Potential long-term impacts from fishery/ aquaculture facilities could result in long-term organic enrichment of bottom substrates.**	**Short-term increases in sedimentation and turbidity from construction.** **Proper siting of seasonal net pens will eliminate long-term adverse impacts.** **Long-term beneficial impacts from creation of new habitats resulting in clean substrata.**

Table 3.4-1 Comparison of Alternatives

	ALTERNATIVES				
CRITERIA	1 NO ACTION	2 SPECIES-SPECIFIC	3 HABITAT FUNCTION	4 ACQUISITION OF EQUIVALENT	5 INTEGRATED APPROACH
1. Potential for direct and indirect benefits to more than one injured natural resource or service.	**Unpredictable** Natural processes determine trajectory of ecosystem. EPA remedial actions will influence potential for ecological benefits.	**Variable** Moderate potential for direct or indirect benefits to specific species (salmonids, demersal fish, shellfish, waterfowl). Less likely to provide for a diversity of species.	**High** Focus on direct and indirect benefits to multiple injured species. Provides benefits for uninjured resources/services. Provides ecological benefits (detrital export, improved water/sediment quality, nutrient flux).	**Variable** Does not attempt to directly restore injured resources and services. Moderate potential for indirect benefits to substantially similar resources or services.	**High** Maximizes potential for direct and indirect ecological benefits to multiple injured species and lost services as well as non-injured resources through habitat restoration and incorporation of options to create or acquire equivalent natural resources and services.
2. Provides an alternative for those resources that will not recover without efforts beyond regulatory requirements for source control, sediment cleanup and habitat restoration.	**Low** No NRDA funds would be spent on restoration.	**Moderate** Restoration actions focus on increasing numbers and/or distribution of specific species or groups of species. Provides an alternative for those species that will not recover without measures beyond regulatory requirements.	**High** Promotes greater habitat and species diversity. Provides an alternative for those species that will not recover without measures beyond regulatory requirements.	**High** Provides mechanism to reduce lag time inherent with habitat creation. Allows options for substituting equivalent resources/services. Provides an alternative for those species that will not recover without measures beyond regulatory requirements.	**High** Habitat function is the core of this alternative, incorporating the best elements from alternatives 2 &4. Provides an alternative for those species that will not recover without measures beyond regulatory requirements.

Table 3.4-1 Comparison of Alternatives

	ALTERNATIVES				
CRITERIA	1 NO ACTION	2 SPECIES-SPECIFIC	3 HABITAT FUNCTION	4 ACQUISITION OF EQUIVALENT	5 INTEGRATED APPROACH
3. Potential for environmental impacts (Cont.)					
Fishery Resources	No direct short- or long-term impacts. High potential for indirect long-term impacts to shellfish and fish because no NRDA actions would be taken to eliminate major factors that currently limit production and survival in the Bay and Basin.	Fishery/aquaculture facilities could result in increased probability of long-term disease impacts, competition, predation, and genetic interactions with native species. Direct benefit to specific species or species groups.	Will improve habitat conditions for anadromous species through increases in quiet areas for rearing, greater number of prey resources, and less stress from elevated water temperatures and suspended sediment loads. Increases in stream flow to benefit anadromous species may adversely impact resident species. Impacts could be minimized through proper timing of actions. Non-anadromous species will benefit from clean substrata.	Same impacts from fishery/ aquaculture facilities as species-specific. Benefits to juvenile anadromous species resulting from increases in limited shallow water habitats would not occur. Actions resulting in larger out-migrating juvenile salmonids or alterations in timing release of juveniles should reduce competition between naturally spawned and hatchery fish. Non-anadromous species may be further adversely impacted as habitat functions on which they depend would not be restored.	All impacts for habitat function apply. More opportunities to use technological solutions to compensate for slow ecological development of constructed habitats. Proper timing in release of hatchery fish should greatly reduce competition with stocks. Off-channel rearing ponds should increase size of juveniles, thereby reducing competition in nearshore habitats as juveniles move offshore.

Table 3.4-1 Comparison of Alternatives

	ALTERNATIVES				
CRITERIA	1 NO ACTION	2 SPECIES-SPECIFIC	3 HABITAT FUNCTION	4 ACQUISITION OF EQUIVALENT	5 INTEGRATED APPROACH
3. Potential for environmental impacts (Cont.)					
Wildlife	Many birds utilize aquatic habitats for feeding. These habitats could be further degraded if No Action fails to result in improvements over existing conditions. Predatory birds could be affected by a reduction in prey.	Direct benefit to specific species or species groups.	Restoration of habitats would improve conditions for resident and migratory birds. Predatory birds would benefit from improved prey availabiliy. Adverse impacts could occur from conversion of terrestrial to aquatic habitat. Careful planning should retain existing functions.	Managing agricultural land for waterfowl food production would directly benefit these species. Wildlife species could benefit from shellfish enhancement. However, there is potential for bioaccumulation if such projects are implemented prior to source control.	All impacts for habitat function apply. Wildlife species could benefit from shellfish enhancement. However, there is potential for bioaccumulation if such projects are implemented prior to source control.

Table 3.4-1 Comparison of Alternatives

	ALTERNATIVES				
CRITERIA	**1 NO ACTION**	**2 SPECIES-SPECIFIC**	**3 HABITAT FUNCTION**	**4 ACQUISITION OF EQUIVALENT**	**5 INTEGRATED APPROACH**
4. Achieves the desired benefit at the least environmental, social and economic cost.	**Low** No economic costs. Environmental Costs: further injury, further habitat fragmentation. Social costs: continued loss of resources/ services.	**High** Costs are well defined and limited to specific scope of actions to benefit target species.	**Moderate** Both costs and benefits high. Cost in urban setting often high. More cost effective opportunities may be available in the Basin.	**Moderate** Cost effectiveness variable due to actions taken.	**High** Uses adaptive management, including use of new more cost-effective techniques. Creating habitats away from known discharge sites could occur in less costly areas of the Basin. Preservaion or enhancement of existing habitats is less costly than creation.
5. Restoration projects will be self-maintaining over the long-term	**Low** No actions taken to improve existing conditions.	**Moderate** Moderate success for actions targeted at critical habitats or limiting factors for injured species. Focus on specific attributes rather than whole ecosystem reduces the likelihood of long-term sustainability. Projects may require extensive ongoing maintenance.	**Moderate** Examples of previous habitat restoration projects have been quite successful, however, it is difficult to replicate natural processes and functions.	**Moderate** Varies by species and service.	**High** Maximizes opportunities for restoring, replacing, rehabilitating or acquiring natural resources and services. Provides the greatest number of restoration options and techniques by integrating the best elements from the other alternatives.

Table 3.4-1 Comparison of Alternatives

	ALTERNATIVES				
CRITERIA	1 NO ACTION	2 SPECIES-SPECIFIC	3 HABITAT FUNCTION	4 ACQUISITION OF EQUIVALENT	5 INTEGRATED APPROACH
6. Reduces fragmentation of landscape by ensuring habitat connectivity, buffers, and access for injured species	**Low** Could increase fragmentation as potentially restorable sites are lost to other uses.	**Low** Restoration is typically piecemeal. Projects could fill certain ecological niches, but very limited ability to alter structure or function of the landscape.	**High** Based on principles of landscape ecology to ensure that projects are structurally and functionally integrated into the landscape.	**Low** Oriented toward replacement of natural resources and services, rather than restoration of habitats.	**High** Based on principles of landscape ecology to ensure that projects are structurally and functionally integrated into the landscape.

landscape and does not achieve landscape ecology goals as well as several of the other alternatives and so does not satisfy the first objective of the CB/NRDA program.

The Habitat Function Alternative should result in net improvement in water and sediment quality over the long-term. In addition, this alternative is specifically designed to improve habitats that function in support of multiple fish and wildlife resources. Some habitat restoration actions could result in short-term impacts, but these impacts can typically be avoided or minimized. The Habitat Function Alternative is one of the best at achieving landscape ecology goals and satisfying the first objective of the CB/NRDA program.

The Integrated Approach Alternative has low to moderate potential for short-term impacts to water and sediment quality, habitat conditions, and fish and wildlife species. Adverse impacts could result from the use of net pens, however, proper siting and the use of seasonal delayed release of net pens under this alternative should not result in any reduction in water and sediment quality. Release of hatchery or net pen fish could increase competition, predation, and genetic interactions with wild anadromous and resident fish species. Proper timing in the release of hatchery fish should greatly reduce competition with native populations. Construction of off channel rearing habitats, in conjunction with hatcheries, should increase the size of juveniles and thus reduce competition in nearshore environments as juveniles move farther offshore.

Because of the higher potential for environmental impacts under the Species-Specific and Acquisition of Equivalent Natural Resources and Services Alternatives, and because of the inability to satisfy the stated goals and first objective of the NRDA restoration program, these alternatives will not be carried forward for further evaluation. They have been eliminated as stand-alone alternatives but, as indicated in Section 3.3.5, some action items of these two alternatives are advanced and contained within the Integrated Approach Alternative. The No Action, Habitat Function, and Integrated Approach Alternatives are carried forward for full analysis of the environmental consequences.

3.5 Summary of Environmental Consequences

The environmental consequences of the No Action, Habitat Function, and Integrated Approach Alternatives are presented in Section 4.4. The limitations of the Habitat Function Alternative include the time lag for habitats to become fully functioning, the higher cost associated with habitat restoration especially in highly urbanized areas, and the inability to provide an alternative for acquisition of the equivalent where restoration of the injured resource or service is technically infeasible or costs are too prohibitive in the judgment of the Trustees.

The Integrated Approach Alternative differs from the Habitat Function Alternative in that it provides more opportunities for providing "upfront" benefits to injured natural resources and services. This would compensate for slow ecological development of constructed habitats through use of technological solutions. By focusing on habitat functions while incorporating the best elements from the Species-Specific and Acquisition of Equivalent

Table 3.4-1 summarizes the discussions of each alternatives presented in Sections 2.1 to 2.5 of Appendix E, and ranks each alternative (high, moderate, or low), according to its ability to satisfy each evaluation criteria. The environmental impacts for each alternative were summarized under evaluation criteria 1. Environmental impacts are likely to occur under every alternative, but most impacts are very difficult to predict at the programmatic level. In general, the Species-Specific Alternative and the Acquisition of Equivalent Natural Resources and Services Alternative have moderate potential for short- or long-term environmental impacts if implemented. The other alternatives should have fewer and shorter-term impacts on the environment (i.e., they are ranked as low-moderate).

The No Action Alternative should have no direct adverse impacts, since no new actions are implemented under this alternative to improve water or sediment quality, habitat conditions, fish and wildlife, or threatened and endangered species. Indirect impacts could result if this alternative fails to result in improvements to existing conditions and habitats continue to be degraded, or if habitats, which could otherwise have been restored under one of the other alternatives, are converted to industrial, commercial, or residential uses. The No Action Alternative is by far the least costly and must be brought forward to meet NEPA requirements. The alternative has a low probability of success in terms of NRDA restoration goals, but could easily be implemented immediately without any direct adverse effects to the environment.

The Species-Specific Alternative has moderate potential for short-term impacts to water and sediment quality, habitat conditions, and fish and wildlife species. Long-term adverse impacts to water and sediment quality could result from construction of new hatcheries, net pens, or aquaculture facilities.

Release of hatchery or net pen fish could increase competition, predation, and genetic interactions with wild anadromous and resident fish species. Although this alternative is perhaps the best suited of the five alternatives to restoration of individual injured species, it is less likely, compared to several other alternatives, to satisfy restoration goals 2 and 3 (providing benefits to more than one injured species and providing an alternative for species that will not recover without efforts beyond regulatory requirements). This alternative has a low potential of reducing fragmentation of the landscape, does not achieve landscape ecology goals as well as several of the other alternatives, and so does not satisfy the first objective of the CB/NRDA program.

The Acquisition of Equivalent Natural Resources and Services Alternative could result in short-term decreases in water and sediment quality, and increased damage to specific habitats. Specific fish and wildlife resources would benefit from this alternative, but these species would be substitutes for the injured resources and services. This alternative is one of the best for providing an alternative for those resources that will not recover without efforts beyond regulatory requirements. However, as a stand-alone alternative, acquisition could only be implemented as a last resort in those cases where restoration of the injured resource or service is technically infeasible or the cost is too prohibitive in the judgement of the Trustees. This alternative has a low potential of reducing fragmentation of the

Natural Resources and Services Alternatives, the Integrated Approach provides overall net improvement in water and sediment quality; improves habitats that function in support of multiple fish and wildlife resources; provides an alternative for acquisition of the equivalent where restoration of the injured resource or service is technically infeasible or costs are too prohibitive in the judgment of the Trustees; and allows for additional measures to reduce the time lag for habitats to become fully functioning.

Under the Integrated Approach Alternative adverse effects could result from the use of net pens, however, proper siting and the use of seasonal delayed-release net pens should not result in any reduction in water and sediment quality (Port of Seattle, 1992). Release of hatchery or net pen fish could increase competition, predation, and genetic interactions with native anadromous and resident fish species. To minimize genetic interactions, appropriate species and stocks should be chosen. Construction of off-channel rearing ponds (in conjunction with hatcheries) should increase the size of juvenile salmonids, thereby reducing competition in nearshore environments because larger juveniles move farther offshore upon entering the Bay. In order to reduce and/or avoid impacts that would result in temporary disruption of fish migrations and spawning, restoration actions should be timed to avoid periods when spawning occurs or when sensitive life stages are present.

3.6 Selection of Preferred Alternative

Table 4.5-1 summarizes the possible restoration actions and the potential impacts that could result from implementation of these three alternatives. Table 3.4-1 summarizes and compares the environmental impacts of the three alternatives. The discussion indicates that both the Habitat Function and the Integrated Approach Alternatives would have beneficial effects on natural resources and services. However, the beneficial effects of the Integrated Approach are expected to exceed those of the Habitat Function Alternative. The Trustees have selected the integrated approach as their preferred alternative for natural resource and service restoration in Commencement Bay.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction and Compliance

This section forms the scientific and analytic basis for the comparisons under sections 1502 and 1508 of NEPA. It consolidates the discussions of those elements required by sections 102(2)(C)(i), (iv), and (v) of NEPA, which are within the scope of the statement and as much of section 102(2)(C)(iii) as is necessary to support the comparisons. The discussion will include the environmental impacts of the alternatives, including the preferred alternative, any adverse environmental effects that cannot be avoided should the alternative be implemented, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources. This section discusses the environmental consequences of implementation of each alternative.

Since the nature of this analysis is programmatic, the cumulative, direct and indirect impacts of the alternative programs will be discussed first, followed by potential project level impacts. Project level environmental consequences will be evaluated through appropriate project-specific environmental documents.

The Trustees intend to avoid or minimize negative impacts to existing natural resources and services to the greatest extent possible. However, the Trustees could undertake actions that would have short- and long-term adverse impacts upon existing habitats or non-injured species. Project-specific evaluation of impacts will be prepared as part of the environmental review process.

4.2 Direct, Indirect and Cumulative Impacts of the Three Alternatives

As defined by the CEQ's NEPA regulations applicable to all federal agencies, 40 CFR Part 1508:

"Direct impacts" are caused by any action and occur at the same time and place.

"Indirect impacts" are caused by actions that are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air water and other natural systems, including ecosystems.

"Cumulative impact" is the impact on the environment which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or Non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Effects and impacts are used synonymously in the CEQ regulations. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of effected ecosystems), aesthetic, historical, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

4.3 Impacts Common to All Alternatives

The following discussion considers potential environmental consequences resulting from any action-based alternative which involves the disruption of land to create a restoration site. This includes the No Action, Habitat Function, and Integrated Approach Alternatives for restoration. Given that this evaluation is programmatic, further descriptions including those regarding source control, erosion control and mitigation procedures are found in the Conceptual Restoration Plan Volume II will be discussed later in the project-specific environmental documents.

Air Quality Impacts

Because there can be no quantitative evaluation of air impacts at the programmatic level, it is important that a discussion of existing air quality was done in section 2.10. This section will qualitatively discuss potential air quality impacts from implementation of each of the alternatives.

An identification of the microscale air quality impacts of the restoration alternatives must be left to discussion of individual restoration projects. However, adverse air quality impacts resulting from any of the alternatives are short-term, caused by the specific land preparation activities, vehicle emissions and near-shore sediment excavation. All of these immediate adverse impacts on air quality are anticipated to cease upon completion of the project construction. Moreover, the term of these construction projects is anticipated to be brief, with most construction not extending beyond a two-to-four week period.

Long-term air quality is expected to improve due to the increase in vegetation in the restoration areas. A slight increase in hydrogen sulfide emissions from an expansion of intertidal habitat is possible when former industrial upland sites are converted to ecologically productive mudflat or marshes. However, the impact is anticipated to be well below the harmful exposure range and will not exceed the hydrogen sulfide levels emitted from a naturally-occurring undisturbed marsh.

Activities undertaken to prepare the land for a particular use could generate air emissions. These activities include clearing, grubbing and earth moving, dredging, soil and sediment storage and transport, digging, grading, burning and planting. All of these activities could generate fugitive dust in amounts roughly correlating to the amount of earth being moved and the term of the activity. The dust being generated by construction activities would be primarily non-reactive silicates. In addition, heavy equipment, marine vessels, and vehicles used to facilitate these tasks will also contribute to the carbon monoxide (CO), nitrogen oxide (NO), particulate, and hydrocarbons. Land preparation, dredging operations, construction dust and vehicular emissions are anticipated to result in temporary, short-term impacts, lasting only for the duration of the construction. Once construction activities have ceased, so will the fugitive emissions and dust.

Reduction of fugitive dust generation may be accomplished in a number of ways, including avoiding dust-generating activities during periods of dry, windy weather; using water trucks or sprinklers to dampen exposed ground and soil piles; using non-toxic chemical stabilizers to prevent dust emissions; time plantings or other ground-covering options (e.g., gravel) to minimize time that soil is exposed to wind and drying; avoiding denuding steep slopes unless they can be quickly replanted; covering truck loads of soil, sediment, sand, gravel, or other ground material during transport; using gravel on unpaved roadway entrances/exits and wheel washes or other cleaning methods to help minimize trackout of mud onto paved roads; and using water sprays, non-toxic environmentally safe chemical stabilizers, well anchored covers, or enclosures to prevent fugitive emissions from storage piles.

Alternatives to burning for the purposes of land clearing or weed control are recommended and will be considered. No open burning is permitted within the Urban Growth Areas as defined by RCW 36.70A.030. If burning is pursued, a permit is required, and meteorological conditions must be suitable as determined by the agency issuing the permit.

Best practical measures will be taken in order to reduce emissions from heavy equipment, marine vessels and vehicles. Such measures may include, but are not limited to, using low-emission diesel-powered equipment; insuring that vehicle and equipment engines are well tuned and maintained; avoiding heavy equipment on days where air is stagnant or impaired air quality has already been determined; avoiding prolonged periods of idling; and avoiding operations that may heavily impact sensitive receptors in the vicinity.

A certain amount of fugitive dust and emissions is anticipated during the course of events involved in construction. Due to the small scale of the activities mentioned above, with the exception of burning, unavoidable fugitive dust emissions are anticipated to contribute an insignificant burden to the ambient air contaminant load and are not anticipated to exceed any ambient air quality standard.

<u>Air Quality Conformity Analysis</u>

Under the Federal General Conformity Rule (40 CFR Parts 6, 51, and 93), direct and indirect air pollutant emissions that are generated within a nonattainment area or a maintenance area as a result of a federal action are regulated. Because the activities proposed in the Restoration Plan constitute actions by one or more federal agencies (Trustees), these activities must be considered for conformity with the State Implementation Plan (SIP). Portions of the primary and expanded study areas lie within the nonattainment areas for three criteria pollutants: the Tacoma tideflats is a moderate nonattainment area for PM-10; a central portion of Tacoma is a moderate nonattainment area for carbon monoxide; and the Tacoma region is part of the Puget Sound marginal nonattainment area for ozone. As precursors to ozone, volatile organic compounds (VOCs) and nitrous oxides (NO_x) are the regulated air pollutants which are subject to conformity within an ozone nonattainment (or transport) area.

Typical activities anticipated for restoration projects whose emissions (including carbon monoxide, particulates, volatile organics compounds, and nitrous oxides) must be included in the conformity analysis include, but are not limited to, those mentioned above. Activities must be specified according to location (inside or outside the nonattainment area boundaries), type of equipment, and hours of operation. From these data, total emission figures for each of the subject criteria pollutants (CO, PM-10, VOCs, and NO_x) can be calculated using EPA emission estimating methods (AP-42 emission factors and Mobile 5a calculated values). These emission estimates are then compared to the conformity thresholds values stated in Table 4.3-1 (40 CFR Parts 51.853 and 93.153).

If none of the applicable threshold values is exceeded, the projects are not subject to further conformity analysis under the SIP. If one or more the threshold values is exceeded, means to offset, mitigate, or otherwise reduce the emissions must be identified so that there is no net increase in the emissions of that pollutant.

The types of projects anticipated in the Restoration Plan are of far smaller scale than highway construction, port dredging, or commercial development projects. The sites where restoration construction are anticipated to occur are limited in size. The term of these construction projects is also anticipated to be short, generally from two to four weeks. One to five projects per year are expected. Therefore, it is considered highly unlikely that annual emissions for these restoration projects will exceed the threshold values stated in Table 4.3-1. However, as the projects are specified and scheduled, the annual emission estimate calculations must be performed to verify that the conformity thresholds are not exceeded.

<u>Noise Impacts</u>

Until individual project areas are specified "noise sensitive", information on the numbers and types of activities which may be affected cannot be addressed. Project-specific environmental assessments, if required, will include an extent of impact (in decibels) including a comparison of the predicted noise levels with both the Federal design noise levels and the existing noise levels and an indication of conformity with any applicable adopted noise standards. Noise abatement measures will be considered and those measures that would likely be incorporated into the proposed project will be addressed on a project-specific basis.

Table 4.3-1. Nonattainment Area Conformity Threshold Values.

Pollutant	Type of Nonattainment Area	Emission Threshold (tons per year)
Ozone (VOCs)	Marginal or Moderate	50
Ozone (NO_x)	Marginal or Moderate	100
Ozone (VOCs or NO_x)	Serious	50
	Severe	25
	Extreme	10
Carbon Monoxide	All	100
Sulfur Dioxide or Nitrogen Dioxide	All	100
PM-10	Moderate	100
	Serious	70
Lead	All	25

NOTE: Shaded portions of the table indicate applicable thresholds for consideration in this Restoration Plan.

Any construction action, such as the creation or enhancement of wetland areas or intertidal zones, dredging, construction of dams and weirs, and their redirection of surface waters, would generate short-term adverse impacts from the employment of heavy equipment. The noise impact would depend upon the nature and location of the activity, surrounding land use and sensitive receptors in the proximity, and the types of equipment used. Long-term measures which might generate noise could include the operation of a fish hatchery, use of easements for property access, and access to monitoring locations. The noise impact of these long-term measures must be evaluated on a case-by-case basis.

An increase in noise from resident and migrating birds is a potential long-term impact. As habitat is restored or improved, birds and other wildlife should become more plentiful in the expanded study area. Overall, the long-term noise impacts of projects under any of the alternatives are anticipated to be far less than other types of developments, including a new highway, operation of a quarry, or other heavy industrial or commercial use activity. More significant at this stage of planning is consideration of short-term construction impacts.

Construction activities undertaken to prepare the land or waters for a particular use could generate noise. These activities could include clearing, grubbing, earth moving, dredging, sediment and soil storage and transport, digging, grading, burning and planting. Ground clearing and excavation typically generate the highest level of noise. Pile driving can produce peak noise levels of about 81-88 dBA at a distance of 50 feet (US DOT, 1990). Trucks, graders, bulldozers, concrete mixers, and similar equipment can generate noise in the range of 67 dBA to 98 dBA at 50 feet (TAMS Consultants, 1993b). If several pieces of heavy equipment are operating simultaneously, the noise impact will be the greatest.

Construction noise is exempt from state and county regulations except from 10:00 p.m. and 7:00 a.m. Should noise mitigation measures be desired, even though not required by regulation, activities near particularly sensitive receptors such as residences, schools, and hospitals could be further limited to specific hours of the day, or operation of heavy equipment could be limited to a very few pieces of equipment at any one time.

Water Quality Impacts

Implementation of any or all of the alternatives should result in few adverse impacts to water quality. Other than the no action alternative, which would result in no direct short-term water quality impacts from the CB/NRDA process, specific actions that could have short-term water quality impacts include excavating, dredging, and other habitat construction activities in or adjacent to streams, rivers, wetlands or the estuary; placement of instream structures, such as woody debris, or log weirs; and transplanting eelgrass. All of these actions could result in short-term increases in sedimentation and turbidity.

Any actions that could result in an increase in sedimentation, turbidity or any other project-specific water quality adverse impacts will be addressed on a project-specific basis. The impacts resulting from restoration construction activities will be mitigated through the use of techniques such as the use of sediment curtains or other technologies designed to reduce sediment transport. Long-term organic enrichment of bottom substrates could be avoided or minimized through careful siting of projects in areas with appropriate tidal flushing and currents. Construction equipment will be monitored to ensure diesel, gas, or oil are not released into waters at or adjacent to the project site. When considered within the context of all the other activities in the watershed which continue to degrade Commencement Bay water quality, the small scale and short duration of potential restoration activities would result in insignificant effects to this resource.

Sediment Quality Impacts

No long-term adverse effects to sediment quality are anticipated, with the exception that improper siting of delayed-release seasonal net pens could result in long-term organic enrichment of bottom substrates. Proper siting of delayed-release net pens would not have long-term adverse impacts upon sediment or water quality (Port of Seattle, 1992). Typical actions with regard to sediment quality result in situations similar to those already mentioned with respect to water quality. However, substrate modification and enhancement for shellfish and demersal fish habitat should improve sediment quality relative to existing conditions, and will be implemented using best management practices to avoid further impacts.

Wetland Impacts

Wetland impacts are solely site-specific. Any environmental document necessary for restoration site construction will include sufficient information to: (1) identify the type of wetlands involved, (2) describe the impacts to the wetlands, (3) evaluate alternatives which would avoid these wetlands, and (4) identify practicable methods and measures to minimize harm to the wetlands. The type of wetlands involved will be identified.

During construction, mitigation measures will be employed, including the enhancement of existing wetlands, creation of new wetlands, erosion control, and, if an important wetland is influenced by surface water flow, bridging. Where there are no practicable alternatives to an action involving new construction in a wetland, the environmental document will contain the finding required by Executive Order 11990 and by US DOT Order 5660.1A in a separate section or exhibit titled "Wetland Findings. Any adverse impacts to wetlands are anticipated to be minor because careful planning and mitigation for adverse impacts would be part of any of the restoration efforts.

Floodplain Impacts

Depending upon the restoration project chosen, it may be necessary to discuss significant effects of the proposed action on areas subject to flooding. Should the preferred alternative involve an encroachment, the final assessment will clearly identify concerns and specific impacts (including beneficial impacts) of the alternative and proposed measures to minimize the negative and maximize the beneficial in order to maintain and enhance the floodplain.

Alternatives which involve construction in the base (100 year) floodplain, regardless of the alternative, will consider and implement best management practices. Changes in water elevations will be evaluated on a project-specific basis.

A separate section entitled "Floodplain Finding" as required by Executive Order 11988, "Floodplain Management," will be incorporated into the final environmental document. Any adverse impacts to floodplains are anticipated to be minor because careful planning and mitigation for adverse impacts would be part of any of the restoration efforts.

Coastal Zone Impacts

If the proposed alternative will directly affect the coastal zone, an assessment shall include a brief description of Washington's Coastal Zone Management Plan, identification of the potential impacts, and evidence of coordination with Ecology, the State's Coastal Zone Management Agency. The final environmental document will include a Coastal

Management Consistency Review, and any project will go through a local and Ecology Shoreline Management review process.

Social and Economic Impacts

Restoration work in the Bay and Basin as a result of proposed alternatives should not have significant adverse impacts upon the neighborhoods or community cohesion for various groups for the following reasons:

No splitting of neighborhoods, no isolation of any ethnic or portion of ethnic group, no new development other than those that would foster public access and awareness of the communities natural resources, should occur. Property values should not be decreased, nor should there be any separation of the communities residents from community facilities.

The general social groups specifically benefitted from the proposed alternatives must be identified on a project-specific basis, however, it is the objective of the Trustees to benefit all social groups. Consideration of particular social groups in the immediate vicinity of any potential restoration site will be identified.

Changes in travel patterns (e.g., vehicular, bicycle, pedestrian), including cross street terminations, will reflect the views of the city and county.

Impacts on schools (e.g., use of the restoration site for educational purposes), recreational areas, fire protection etc. will be discussed on a project-specific basis.

Regional economic impacts, such as the effects of any alternative or project on the spatial distribution of development, will be insignificant. Restoration projects will not lead to commercial development, and the environmental assessment should provide information on the effect of the pending action on established business districts, the economic health of the business district that might be adversely impacted, and the willingness and desire of the public and private sectors to cooperatively strengthen development and revitalization opportunities in business districts.

Displacement Impacts

Federal policy mandates that it is necessary for an EIS to address displacement impacts in the form of a complete relocation plan or summary to adequately explain the relocation situation along with a resolution of anticipated or known problems. Due to the nature of the Restoration Plan and the programmatic application to the process, there are no anticipated relocation issues.

Land Use Impacts and Aesthetics

The City of Tacoma has adopted a goal for land use in and around Commencement Bay. The goal is to provide for a working waterfront of mixed uses that contributes to a strong local and state economy, coexists with the natural resources and the ecology of the Bay, enhances the character of the Port industrial area, and improves the quality of life in the adjoining areas.

This goal encourages land uses that sustain a long-term socio-economic base for trade, manufacturing, maritime, and service industries in the Tideflats, complemented by retail and residential uses on the eastern and western shores of the Bay, and mixed light industrial, residential and agricultural uses south of the I-5 corridor in the Hylebos, and Wapato Creek drainage basins. This goal also creates and strengthens connections between downtown, other areas and the Bay.

General land use patterns and aesthetic qualities should not be adversely affected under any alternative for the following reasons. Open space and recreational uses are scattered throughout the primary study area; the expanded study area is dominated by open space, agricultural and forested areas. Land ownership may be affected if direct land purchase is required, however this should not affect the overall balance of ownership patterns within either the primary or expanded study areas. Land management practices will not be affected since the pertinent local plans and ordinances, as well as state planning regulations, encourages the preservation and restoration of the area's vital natural resources.

Many of the potential restoration sites identified are in the Tacoma Harbor Area "use classes." Harbor Areas, as defined by the State Department of Natural Resources are, in descending order of priority: 1) water dependent commerce; 2) water-oriented commerce; 3) public access; and 4) interim use (WAC 332-30). Preservation and restoration of natural resources are not addressed under these regulations as administered by the Washington Department of Natural Resources (Teissere, 1996).

Public access to natural resources could benefit under these alternatives, if restoration projects included trails, view points, and interpretive signs. In such case, given that roadways and parking must be provided for viewing areas, environmental degradation might result. It is the goal of the Trustees to balance the goals of public access and habitat restoration in the design process.

Descriptions of current development trends, and the federal, state, tribal and local government plans and policies, have been reflected in the area's comprehensive development plans, including land use, transportation, public facilities, housing, and community services. Restoration site planning, construction and maintenance would not significantly impact development planning for the Bay.

Site-specific documentation will assess the alternative's potential to induce growth and the alternative's consistency with applicable comprehensive development plans adopted for the area. Land use will affect the potential for the success of any restoration project more than restoration activity will impact land use. Land for restoration must not only be available, but it must also be compatible with existing plans and federal, tribal, state, and local regulatory constraints on the use of land for restoration purposes.

State Managed Aquatic Lands

Different statutes, regulations and guidelines apply to different properties. Harbor areas, as mentioned above, are an excellent example. Article 15 of the Washington State Constitution established the Harbor Line Commission to create harbor areas to be forever reserved for landings, wharves, streets and other conveniences of navigation and commerce. Section 1 of Article XV states: ". . .nor shall any of the area lying between any harbor line and the line of ordinary high water, and within not less than fifty feet and not more than two thousand feet of such harbor line (as the commission shall determine) be sold or granted by the state or its rights to control the same relinquished. . ." Section 2 of Article XV limits the terms of a lease within a Harbor Area to thirty years.

Harbor Area use classes are listed above. A restoration site would be considered an "interim" use by the Washington State Department of Natural Resources (WDNR). Therefore, should the space occupied by the restoration area become necessary for water-dependent commerce or water-oriented commerce, that space must be made available for those uses. The WDNR is constitutionally restricted to offering thirty year leases in these areas. Land used for restoration within the City of Tacoma Harbor Area cannot be considered as set-aside lands in perpetuity. Coordination with other programs concerning issues such as these will be done as early as possible in order to analyze public land uses and regulatory, statutory and constitutional issues. There are still issues that must be discussed with regard to State-owned aquatic lands. Restoration areas and their perceived potential impact upon commerce would be addressed on a site by site basis.

Historical and Archaeological Impacts (Cultural Resources)

The project area contains numerous recorded archeological and historical sites. Additionally, large areas within the Bay and Basin have never been subjected to systematic surface or subsurface investigation, so there is strong potential for additional unrecorded cultural resources. Potential restoration projects could affect prehistoric sites, historic shipwrecks, historic buildings, and Native American traditional cultural properties.

Resources on or determined to be eligible for the National Historic Register of Historic Places must be identified as potential impacts of these resources by the alternatives under consideration. However, each site must be evaluated on a case-by-case basis. It is not the intention of the Trustees to adversely impact historical or archaeological preservation. As specific projects are identified, research and field investigations will be undertaken in consultation with the Washington State Office of Archeology and Historic Preservation, the National Advisory Council on Historic Preservation, Indian Tribes, and local governments, in accordance with Section 106 of the National Historic Preservation Act (36 CFR Part 800). Since all site specific projects would be designed to identify historic properties and mitigate for any potential impacts, it is not anticipated that historic properties would be significantly affected under any of the action alternatives.

Energy

Since all of the action alternatives should meet the energy goals and objectives of the CB/NRDA restoration process, none of the alternatives should have an impact upon energy consumption.

Fish and Wildlife Impacts

The basic goals and principles of NRDA restoration are encompassed in the idea of providing diverse and self-sustaining habitat types to enhance fish and wildlife within the Commencement Bay ecosystem. Only the no action alternative has the potential of doing significant, long-term harm. The chances of any NRDA restoration project having a negative impact upon fish and wildlife are insignificant, and is limited only to the duration of construction activities. This impact is evaluated later in this section.

Prime and Unique Agricultural Lands

Information on prime and unique agricultural lands will be solicited from the United States Department of Agriculture and the Pierce County Extension Service upon selection of specific NRDA restoration sites.

Considerations Relating to Pedestrians and Cyclists

Section 682 of the National Energy Policy Act of 1978 recognizes that bicycles are an efficient means of transportation, they represent a viable commuting alternative to many people, and deserve consideration in a comprehensive national energy plan. Section 109(n) of the 23 USC provides that, "The Secretary shall not approve any project under this title that will result in the severance or destruction of an existing major route for non-motorized transportation traffic and light motorcycles, unless such a project provides a reasonable alternate route or such a route exists." Where appropriate, and required, any assessment will consider pedestrian and bicycle use as an integral feature of projects, and will discuss the relationship of the proposed project to local plans for bicycles and pedestrian facilities.

Visual Impacts

Project-specific evaluations will include an assessment of the temporary and permanent visual impacts of the proposed alternatives. Where relevant, any assessment would include consideration of design quality, art and architecture in the project planning. These values may be particularly important for restoration project sites in sensitive urban settings. Any documentation resulting from such considerations would be circulated to officially designated state and local arts councils, and other organizations with an interest in design, art and parks.

Construction Impacts

This portion of the impact analysis is the most important of all sections as, with the exception of the No Action Alternative, immediate impacts of construction would constitute the only significant impacts. To minimize noise impacts from construction, specifications will be implemented setting maximum noise levels, restricting work hours, utilizing quiet construction equipment, or otherwise reducing or limiting noise impacts. Disposal of waste materials, and the effect on borrow areas and disposal sites, would be considered and concerns would be addressed on a site- and project-specific basis. Environmentally sensitive areas would be avoided as borrow or disposal sites. Where special problems are involved, mitigation measures will be discussed.

Measures to minimize erosion, sedimentation and turbidity in water bodies and dust in inhabited areas will be addressed and maximized.

Measures to minimize effects on traffic and pedestrians during construction will be undertaken.

Energy impacts of construction, including energy used by construction equipment and significant impact or use of natural resources will be addressed.

Finally, impacts of air pollution and fugitive dust, and any measures proposed to control dust will be explored.

4.4 Alternative-Specific Impacts

Impacts common to each of the restoration alternatives have been discussed previously; specific impacts potentially resulting from the three selected alternatives are addressed in the following sections.

4.4.1 No Action Alternative

Overall *habitat quality* could be adversely impacted in the long-term by the No Action Alternative. The No Action Alternative could indirectly result in further loss of the few viable estuarine and riverine habitats that remain in the Bay and Basin, if no action leads to continued degradation of these habitats rather than natural recovery. Of particular concern are mudflats, which represent the largest remaining viable habitat type in the Bay, and which provide nursery, feeding and resting habitat for avifauna and mammals. In addition, vacant lands/property which might have been enhanced or restored for injured natural resources or services under one of the other two alternatives, could be developed under this alternative. Such development would result in further losses of habitats and their functions, as well as increased fragmentation of the landscape.

Under this alternative, adverse impacts would be maintained in the short-term. There is a very realistic potential for additional long-term impacts to shellfish and fish resources, because no NRDA action would be taken to eliminate the major factors that are currently influencing fish and shellfish production and survival in the Bay. *Fisheries* resources would continue to be stressed by elevated temperatures, flow diversions, lack of vegetative cover, dams and other barriers to migration, road construction or other development in or adjacent to fish habitat, irrigation for farming, and draining of wetlands (e.g., Ecology 1995a, South Puget Sound Spring Chinook Technical Committee 1995).

The No Action Alternative could adversely impact *wildlife* over the long-term because no action would be taken to enhance or restore habitats that support reproduction, feeding, and rearing of mammals, shorebirds or waterfowl. Many resident and migratory birds that occur in the Bay may preferentially use aquatic habitats for feeding. If the No Action Alternative results in the further degradation of the mudflats, marshes, and eelgrass meadows in the Bay, mammals, shorebirds, and waterfowl would all be adversely affected. In addition, alteration of vacant uplands from vegetated to commercial/industrial or residential uses would most probably result in reduced support for upland species that exist in the region.

Under the Endangered Species Act (ESA), habitat restoration and preservation is the most important element of most recovery plans for threatened and endangered species. This alternative reinforces the potential for continued loss of prey resources and critical habitats for feeding, nesting and rearing of endangered species (Appendix C).

The No Action Alternative is by far the least costly and must be brought forward to meet the NEPA requirements. The alternative has a low probability of success in terms of NRDA restoration goals, but could easily be implemented immediately. Short-term impacts are no more severe than the current state of the Bay; in the long-term, without significant improvement in planning and policy, this alternative would likely result in continued degradation of the Bay.

4.4.2 Habitat Function Alternative

Habitat function restoration focuses on providing direct and indirect ecological benefits to multiple injured species. This alternative would also benefit uninjured natural resources and services. Typical actions include land acquisition and enhancement, creation of new habitat, or restoration of existing habitats. In addition, habitat restoration typically provides benefits outside the project area, including detrital export, improved water and sediment quality, and nutrient flux. Although the long-term effects of the Habitat Function Alternative would be beneficial, short-term adverse affects could result from construction activities.

Adverse environmental impacts of the Habitat Function Alternative should be minimal. There is some potential for actions that benefit one group of species to have negative short-term impacts on other species. In addition, increased interaction between predators and injured prey species may result. However, the goal of this alternative is to restore habitats that provide functional benefits (e.g., feeding, refuge, reproduction) to multiple natural resources and services injured by contamination. Implementation of this alternative should improve overall conditions in the Bay and Basin for most fisheries resources.

Adverse impacts to *wildlife* could occur by conversion of terrestrial habitat to aquatic habitat (for example, the conversion of vacant land to riverine or emergent or palustrine marsh). Upland bird species and small mammals would be adversely affected by such habitat conversions. Carefully planned habitat restoration would leave some of the upland habitat intact as a buffer to adjacent aquatic habitat, and would retain existing functions for upland species.

Non-anadromous species inhabiting the study area should benefit from this alternative. This alternative would reduce the incidence of histopathological disorders, and would decrease the concentration of body burdens of contaminants, due to the placement or exposure of clean sediments that will form the substrata for development of high quality habitat functions.

Implementation of this alternative should improve conditions for injured fish and wildlife. Previous examples of habitat function restoration demonstrate it is possible to improve the functioning of benthic habitats, to initiate recovery of natural habitats such as eelgrass and salt marshes, to improve the health of fish and shellfish, and to improve habitat for nesting, feeding, and rearing of shorebirds and waterfowl. Juvenile anadromous fish, including chum, pink, coho and chinook salmon, and steelhead trout, should also be improved through increases in quiet areas for rearing and feeding, greater numbers of prey resources, and less stress from elevated water temperatures and suspended sediment loads.

Under this alternative, no adverse impacts to *threatened or endangered species* are anticipated. The range of possible actions to restore habitat functions would be expected to indirectly benefit the endangered peregrine falcon, threatened bald eagle and marbled murrelets, and to directly benefit the critical White River spring chinook salmon stock. Habitat restoration should result in increased prey resources and nesting and feeding habitat for all avifauna, and should increase feeding and rearing habitat for spring chinook salmon.

Under this alternative, a diversity of impacts to the local *soils and geologic setting* would occur. The most significant impact would be from restoration actions transforming upland area environments into wetland conditions. Modifying the riverine or palustrine environments, such as by restoring the natural channel geometry, would cause a redistribution of sediment and soil materials. It would also alter the processes such as erosion and deposition that influence these soils, especially as the river migrates across the new zone. However, these adverse affects are not considered to be significant in the long-term.

A major impact to soils would be the excavation of uplands to create palustrine wetlands. Many of these areas consist of agricultural or vacant lands with organic nutrient-rich topsoil. These surface soils would be excavated and removed, and the underlying natural alluvial or fill soils would then form the surface horizon in these areas. These soils would likely not be as organic-rich, and may not form as suitable a substrate for plant growth. This would leave the soils more susceptible to erosion.

Minimal direct adverse long-term impacts to soils or geologic conditions would result from the implementation of this alternative. However, for excavation of areas with rich organic topsoil, this material should be stockpiled, then replaced on site after excavation, and then revegetated. This would promote the most rapid growth and stabilization of the soil, and would include a native seedbank.

Under this alternative, a diversity of impacts to the local and geomorphic setting would occur. The most significant impacts would be restoration actions that modify the riverine and palustrine environments, especially those that transform upland areas to wetlands, or that connect wetland areas with the river. Significant *hydrologic* modifications would result from any restoration actions that breech river dikes to restore wetlands, that return agricultural lands to their former hydrologic conditions, or that restore the natural channel or oxbow geometry. The greatest change would occur in those areas near riverine environments that are potentially in hydraulic connection to the river. Many of these restoration actions would create areas where river water is capable of spreading out laterally, at least during flood stages. This would allow for enlargement of the effective flood plain on the Puyallup River and would result in lower flood-peak water levels in this reach of the river. Because a larger flood plain and backwater zones (including oxbows) would be in hydraulic connection to the river, some deposition of fine-grained sediment being carried by the river would occur in these areas. Due to the present river channelization, much of this sediment is now carried downstream and deposited in Commencement Bay. The potential NRDA restoration actions would decrease the amount of sediment transported downstream, thereby slowing the sedimentation rate in the Commencement Bay delta.

Restoring the natural channel geometry of the river and oxbows would also cause reworking and redistribution of sediments as the river channel begins to migrate through new zones. This would be in accord with original variability of contours and would provide a greater variety of habitats and edge conditions.

Creating *wetlands* may affect groundwater levels and would add complexity to the entire hydrologic regime. Increasing base flow could be a beneficial affect. However, if groundwater is contaminated, creating a direct connection between it and the surface water would transport contaminants to the surface, potentially impacting aquatic habitats.

Overall, this restoration alternative should have a positive effect on water quality. Aside from the temporary increases in turbidity or sedimentation resulting from construction activities that are necessary to restore specific types of habitats, long-term water quality disturbances would be avoided. Additionally, chronic suspended sediment can decrease growth of anadromous salmonids, increase competition for food, increase susceptibility for disease, and reduce successful migration (Beschta et al., 1995). Cumulative effects of sediment loading and contaminants add to downstream degradation of water quality.

Increasing instream flows may result in both short- and long-term impacts upon water quality through increased mobilization or transport of sediment, especially in areas where considerable sediment has built up due to reduced flows.

Wetlands can have a cleansing effect on water (Mitsch and Gosselink, 1993). Dissolved contaminants and suspended particulate matter (which can have associated contaminants) are effectively removed from waters that pass over a wetland. The materials, once in the wetland, can be further acted upon through burial. Wetland biofilter systems are employed for treating domestic waters and agricultural runoff of certain types as well as highway and other paved area runoff. Restored wetlands, therefore, could improve water quality in associated water bodies.

Typical actions under this alternative can result in short-term increases in *sedimentation and total suspended solids*. These increases would be expected to be limited to short-term construction effects. In the long-term, construction of new habitats or restoration and enhancement of existing habitats under this alternative should result in exposure or placement of clean sediments that will form substrata for development of high quality habitat functions. In addition, wetlands could be restored under this alternative to function as sediment traps and filters. Sediment and soils, an often overlooked component of habitat restoration, are important because they directly determine the plant communities that will persist at a restoration site.

One of the drawbacks to the Habitat Function Alternative is that there may be a significant lag time (greater than five years) before diverse ecological function is replaced. Also, existing viable habitat may have to be altered (e.g., creation of wetland from a viable upland habitat, dike breaching). Recognizing the significant lag time between habitat restoration and the replacement of ecological functions, interim consideration could be given to other alternatives, or components of other alternatives, such as the acquisition of equivalent natural resources, to reduce the time period of departure from existing conditions.

The Habitat Function Alternative offers moderate to high potential for benefiting a number of injured resources. In addition, impacts from implementation are low to moderate. The Habitat Function Alternative has a high potential for reducing habitat fragmentation, as well as optimizing the restoration of injured natural resources or lost services in view of the existing physical and chemical modifications in the study area. Habitat restoration would directly benefit functions that support injured and non-injured fish and wildlife resources, and lost services. Habitat functions are one primary aspect of a holistic plan to improve injured resources. Improvement of habitat functions has been the primary method for conducting coastal aquatic restoration over the past 15 years (Simenstad and Thom, 1992). There is a relatively long history documenting the success of this type of action; the technology of habitat restoration has shown continuous improvement. This history has demonstrated that fisheries and wildlife resources can benefit from the construction and rehabilitation of natural habitats. In addition, there is a growing body of knowledge indicating that restoring wetland habitats can result in improved functions such as nutrient processing, sediment trapping, and flood control. This alternative offers a growing level of confidence to restore functioning habitats for injured resources.

Landscape and Ecological Functions Scenario Examples

To aid in quantifying the effects of NRDA habitat restoration under all alternatives, a state-of-the-art computer program, FRAGSTATS, was utilized to provide a hypothetical quantification of potential changes in landscape structure. This section summarizes the results of the analysis of four hypothetical restoration scenarios in the primary study area, and of one scenario for the Hylebos subsystem. The purpose of this analysis is to demonstrate how various restoration actions might affect the ecological conditions in these areas.

The restoration scenarios were chosen as examples of large-scale changes that follow the overall goals of habitat function restoration in the system. The scenarios represent four types of habitat conversions that make "ecological sense" in terms of location in the landscape. For example, areas designated vacant in 1995 that were adjacent to the Puyallup River and upstream of tidal and salt water influence (i.e., upstream of Interstate 5) were converted to riverine emergent marsh. These scenarios are only provided as examples and are not intended to show precisely or necessarily what should or will be done, or what is feasible. These scenarios provide information on the scale of restoration necessary to result in a landscape level change. Baseline conditions for the area may be found with a more detailed explanation in Appendix C. The four scenarios evaluated for the entire primary study area were as follows:

- 151 hectares of vacant land adjacent to the Puyallup River and upstream of tidal influence was converted to riverine emergent marsh (Appendix C, Figure C-2)

- 1,418 hectares of agricultural land was converted to palustrine emergent marsh (Appendix C, Figure C-3)

- 182 hectares of vacant land within tidal and salt water influence was converted to estuarine marsh (Appendix C, Figure C-4)

- 25 hectares of agricultural patches within the Hylebos subsystem was converted to palustrine emergent marsh (Appendix C, Figures C-5, C-6).

Finally, a separate analysis was conducted and landscape metrics were calculated solely for the Hylebos subsystem. Under this analysis, 25 hectares of agricultural land within the Hylebos subsystem was converted to palustrine emergent marsh. This latter example illustrates the potential for carrying out restoration within a component subsystem within the overall landscape.

The results of the four scenarios suggest that conversion of agricultural land to palustrine marsh, conversion of vacant land to estuarine marsh, and conversion of vacant land to riverine marsh would provide the greatest benefits to injured species. Conversion of agricultural land to palustrine marsh results in the greatest reduction in fragmentation and largest increase in patch area, but it primarily benefits palustrine animals. Conversion of vacant land into riverine marsh primarily affected edge measures which would favor species that utilize edges in this portion of the river, including juvenile salmon, other fish, mammals, and some waterfowl. Although converting vacant property to tidal marsh does not reduce fragmentation, it does restore very important historical estuarine habitat, and it increases the access (indicated by increased edge contrast) and quality of habitat available for estuarine and migratory fish species. This latter scenario perhaps is more realistic in terms of size and availability of property than the former two. However, the analysis does indicate that relatively large parcels of land are needed to predictably measure ecological improvement on the landscape-scale. This analysis also verifies that relatively small-sized conversions have little effect on the entire landscape but can have substantial effects on a subsystem.

4.4.3 Integrated Approach

The Integrated Approach involves a mix of all of the alternatives.

The Habitat Function Alternative is the core of the Integrated Approach Alternative. In addition to the typical actions that could occur under the Habitat Function Alternative, specific components from the Species-Specific Alternative could include but are not limited to: creating or enhancing rearing, feeding, or spawning habitat for selected injured fish and wildlife species; creating seasonal salmonid net pens, and modifying substrate materials at locations in the Bay where appropriate habitat and water quality conditions exist to make it more conducive to shellfish and demersal fish needs; and improving food production and access to food by creating and enhancing tidal channels and emergent marshes.

In addition, components from the Acquisition of Equivalent Natural Resources and Services Alternative are also part of the Integrated Approach. These components include: off-channel rearing ponds in conjunction with existing hatcheries; improving ecological services to the Bay through habitat protection, or by providing a diversity of habitat types and food chain support; facilitating cultural services such as subsistence and ceremonial practices; and creating habitats away from known discharge sites to provide equivalent services within the region for fish and wildlife production.

In the Bay and Basin, the environmental consequences of some of the typical actions that may occur under the Integrated Approach include all of the same generic impacts predicted under the Habitat Function Alternative, including short-term disturbances from noise and air pollutants from construction activities; short-term water, air and sediment quality impacts; temporary disruption of animal migrations, breeding and nesting; short-term disturbances of existing plant communities; and temporary disturbances of ecological processes while the restored system reaches maturity.

The Ecological Society of America (1995) advocates a proactive approach of ecosystem-level protection that would complement existing legislation and protect our nation's biological heritage at lower long-term cost than species level protection. Thus, without understanding the linkages between habitats at the landscape scale, it is difficult to predict the environmental consequences of restoring one particular habitat to adjoining habitats and their fish and wildlife assemblages.

The Integrated Approach Alternative would generally benefit most fish and wildlife species in the long- term through the reduction of fragmentation, increase in the quality of habitats diversity, and function improvements of habitat and improved connectivity. The integrated alternative differs from the habitat alternative in that it provides more opportunities to provide up-front benefits to compensate for impacts due to slow ecological development of constructed habitats through use of technological solutions.

Fish and wildlife impacts from the integrated alternative could result in increased probability of long-term competition, predation, and genetic interactions between artificially produced fish and native anadromous fishes. Under this alternative, there is also an increased probability of long-term disease impacts to fish and shellfish if seasonal net pens are constructed or seeding for shellfish occurs.

As with the Habitat Function Alternative, the Integrated Approach could have short-term noise, air, and sediment quality impacts related to construction activities. In order to reduce and avoid impacts that would result in temporary disruption of fish migrations and spawning, restoration actions should be timed to avoid periods when spawning occurs or when sensitive life stages are present. To minimize potential generic interactions, appropriate species and stock should be chosen. In order to reduce the probability of disease enhancement, facilities would be monitored for cleanliness and compliance with best management practices. Disturbances of animal and plant communities would be avoided or minimized through careful project siting, including public access and viewing areas. Impacts to anadromous and resident fish may be reduced by minimizing the duration of construction activities.

No adverse impacts to threatened or endangered species are expected to result from the Integrated Approach Alternative. If actions under this alternative are determined to have an adverse affect, the project would be redesigned, relocated or possibly abandoned. This alternative could indirectly benefit a variety of federally threatened and endangered species and Washington State listed sensitive species by providing nesting, feeding, resting, rearing and other forms of habitat utilized during the lives of these species. This alternative could directly benefit the critical White River spring chinook salmon stock through increased feeding and rearing habitats and the use of seasonal net pens to increase rearing areas.

Other impacts with respect to topography, soils, geology and hydrology are those mentioned previously in the habitat and general impacts sections. No direct adverse long-term impacts to soils or geologic conditions should result from implementation of the alternative. Under this alternative, some impacts to the local and regional geomorphic setting could occur. The most significant impact would be restoration actions that create tidal channels, emergent marshes, or even habitats to provide some equivalent services. Significant hydrologic modifications would result from any of the restoration actions that create new wetlands; these changes may also permit salt water encroachment which could impact groundwater. Erosion and sediment controls would be implemented.

Short-term impacts such as increased sedimentation and turbidity as a result of restoration construction activities, placing of in-stream structures, and transplanting eelgrass would be offset by the use of sediment curtains or other technologies used to reduce sediment transport. Long-term organic enrichment of bottom substrates could be avoided or minimized through careful siting of projects in areas with appropriate tidal flushing currents.

In general, this alternative should improve water and sediment quality in the Bay and Basin. However, some specific actions that have potential short-term impacts to local water and sediment quality could be implemented (e.g., stocking fish, seasonal net pens, excavating, dredging, placing instream structures, and other construction activities involved in habitat function restoration). Some actions should improve existing conditions for injured fisheries resources and waterfowl (e.g., restoring wetlands to trap and filter sediments; restoring natural channel geometry; stabilizing and fencing stream-banks; planting riparian buffers; removing culverts).

4.5 Rationale for Selecting the Preferred Alternative

<u>No Action Alternative</u>

The adaptations of many plant and animal populations to natural disturbance have not proven effective in coping with most anthropogenic disturbances. The result of human disturbances in most urban estuaries has been cumulative degradation of ecosystem structure and function. The No Action Alternative assumes that all ecosystems are dynamic and continually changing, and thus natural recovery will slowly occur through time, as populations will either adapt to the degraded condition of the Bay or disappear, and natural disturbances (e.g., fire, sedimentation, erosion, earthquakes, sea-level rise) will eventually displace or remove the human disturbances from the system.

The No Action Alternative would leave restoration of natural resources to existing processes and programs. It would not accelerate restoration of healthy fishery resources and habitat beyond what might result from existing processes and programs. The result could be that members of the Puyallup and Muckleshoot Tribes and other members of the low-income groups who rely on the Commencement Bay's fishery resources and services for subsistence would lose the benefit of earlier restoration of food resources on which they rely.

The principal advantages of this approach are that it is easy and involves no monetary cost because natural processes determine the trajectory of the system rather than humans. This approach, more so than any of the others, recognizes the tremendous capacity of estuaries, bays, basins and entire watersheds for self-healing and does not in any way alter existing habitats.

The major drawback of the No Action Alternative is that natural recovery is nearly impossible to predict in a time-frame that is meaningful to humans. Furthermore, Cairns (1989) suggested that even if the stress that produced the disturbed condition is removed or markedly reduced, unaided natural processes may not result in a return of the ecosystem to a previously existing condition. Due to the long time frame associated with natural restoration and the other above reasons, the No Action Alternative has not been identified as the preferred alternative.

Habitat Function Alternative

The objective of restoration is to emulate a natural, self-maintaining habitat or ecosystem that is integrated ecologically within the landscape in which it occurs. Several Pacific Northwest estuarine projects (e.g., Grays Harbor Slough, Jetty Island berm and salt marsh) provide good empirical evidence that creation, although difficult and costly, can be effective. In addition, Cairns (1989) suggested that a real opportunity for restoration ecology is to create ecosystems specifically to untangle spatial and temporal processes.

The tremendous complexity involved in creating a new habitat or ecosystem makes this alternative risky. In many urban bays and estuaries, we are constrained by the lack of quantitative data to successfully mimic the habitat structure and to replicate the complex suite of processes and functions of the reference ecosystem. Thus, the probability of failure is often considered too high to warrant the risks associated with creation of a new habitat or ecosystem. Thus, for the above reasons, the Habitat Function Alternative has not been identified as the preferred alternative.

Integrated Approach Alternative

According to the Ecological Society of America (1995), often the best approach for restoring habitat is to control the source of the degradation and let nature take its course. Unfortunately, habitats such as the Commencement Bay and Basin are often very badly degraded. Fortunately, this area is large enough to contain the potential for heterogeneity, and restoration is feasible through active management and a programmatic, integrated approach. Although environmental impacts inevitably result from construction activities necessitated through an active management approach (versus no action), the impacts of the integrated approach are typically short-term and easy to avoid or mitigate through careful project planning. In addition, the long-term net gain from restoration typically outweighs short-term adverse impacts.

Overall, the Integrated Approach, which is the preferred alternative, has the highest probability of meeting the three restoration goals established by the Trustees. The meaning of "integrate" is "to form, coordinate, or blend into a functioning, or unified whole" (Webster's Ninth New Collegiate Dictionary, 1984). This definition is consistent with the Trustee's vision and goals for restoration in the Bay and Basin, which calls for restoring (blending) the many existing injured species, habitats, and services into a functioning, unified whole. The Integrated Approach, more than the other alternatives, fosters planning at the landscape level to achieve broad statutory and ecological objectives. Under this alternative, the emphasis is shifted to providing a diversity of sustainable habitat types and species, rather than actions that benefit only one species or one habitat type.

The Habitat Function and Integrated Approach Alternatives would accelerate recovery of natural resources relied upon by members of the Puyallup and Muckleshoot Tribes and members of the low-income communities in the Commencement Bay Area at a rate greater than the No Action Alternative. The Integrated Approach Alternative would accomplish this goal and does so on a sustainable basis into the future.

Recognizing that many of the environmental impacts would be project specific and thus cannot be predicted at this stage of the programmatic EIS, generic impacts and considerations, as well as corresponding current and future mitigation measures, are presented here. Table 4.5-1 summarizes the possible restoration actions and the potential impacts that could result from implementation of each of these three alternatives. Table 4.5-2 summarizes proposed mitigation measures to avoid or minimize the adverse environmental impacts listed in Table 4.5-1. Table 4.5-2 also provides guidelines of the most appropriate and feasible measures that could avoid or minimize negative impacts associated with implementation of a specific restoration project. These guidelines should be followed during the development of each project, and are found in greater detail in the Restoration Plan (Volume II).

As described in Section 2.4.2, the integrated approach has the highest probability of meeting the goals established by the Trustees for the Commencement Bay restoration program, including providing a diversity of sustainable habitat types and species.

In summary, the integrated approach:

- optimizes restoration of natural resources and services in view of existing physical and chemical modifications to the primary and secondary study areas;
- has the highest probability of providing a diversity of sustainable habitat types and species within the Bay and Basin;
- provides the greatest flexibility and the most options for restoring, replacing, rehabilitating, and/or acquiring the equivalent of natural resources and services injured as the result of the release of hazardous substances or discharges of oil;
- is the alternative most likely to provide ecological benefits to multiple species;
- has a low to moderate potential for environmental impacts or additional injury to natural resources and/or services;

Table 4.5-1. Summary of Possible Restoration Actions Under Each Alternative and Potential Adverse Impacts.

Restoration Alternatives and Actions	Adverse Impacts [a]
No Action	
• no new restoration actions undertaken	none [b]
Habitat Function Restoration	
• building intertidal beaches	1, 2, 3, 4, 5
• breaching of river dikes/restoring wetlands	1, 2, 3, 4, 5
• excavating uplands/creating palustrine wetlands	1, 2, 3, 4, 5
• returning natural hydrology to agricultural lands	1, 2, 3, 4, 5
• planting riparian buffers with native vegetation	2, 3, 4, 5
• transplanting eel grass	1, 2, 3, 4, 5
• restoring natural channel geometry	1, 2, 3, 4, 5
• reconnecting oxbows	1, 2, 3, 4, 5
• creating mainstem fish spawning and rearing habitat	1, 2, 3, 4, 5
• creating off-channel fish rearing habitat	1, 2, 3, 4, 5
• restoring instream flows	2, 3, 4
• removing flow diversions	1, 2, 3, 4, 5
• removing culverts, roads, other migration barriers	1, 2, 3, 4, 5
• stabilizing and fencing streambanks	1, 2, 4
Integrated Approach--all of the activities under habitat function, plus:	
• artificial fish enhancement (e.g., seasonal net pen)	1-9
• enhancing fish and wildlife feeding, rearing, breeding	1, 2, 3, 4, 5
• modifying substrate/seeding clams or oysters	1, 2, 3, 4, 5
• creating/enhancing tidal channels and emergent marshes	1, 2, 3, 4, 5
• facilitating cultural services and avoiding impacts to cultural resources	none
• creating habitats to provide equivalent services	1, 2, 3, 4, 5, 8
• creating public access/viewing areas	1, 2, 8
• purchasing tidelands, natural wetlands, riparian corridors	none

(a) Adverse Impacts: 1 = short-term noise and air impacts from construction activities (e.g., clearing, grubbing, earth moving, dredging, burning, storing and trasporting soil and sediment) or short-term impacts from increased concentrations of animal species; 2 = short term water quality impacts (e.g., increased sedimentation, turbidity); 3 = temporary disruption of animal migrations, breeding, nesting; 4 = short-term disturbance of existing plant communities; 5 = temporary disturbance of ecological processes (e.g., detrital export, nutrient flux, primary production); 6 = increased probability of long-term disease impacts; 7 = long-term organic enrichment of bottom substrates; 8 = long-term disturbance of animal and plant communities; and 9 = increased probability of long-term competition, predation, and genetic interactions.

(b) Although no direct adverse impacts will result from implementation of the no action alternative, indirect long-term impacts could occur: 1) if natural recovery fails and existing habitats continue to be degraded, or 2) if vacant habitats, which could have been restored under either of the other two alternatives, are converted to industrial or residential uses.

Table 4.5-2 Summary of Proposed Mitigation Measures for Adverse Impacts.

Adverse Impacts	Proposed Mitigation Measures
Short-term noise and air impacts [a]	minimize noise impacts by using appropriate noise abatement measures; avoid or minimize air impacts by using mitigation measures
Short-term water quality impacts [b]	minimize impacts by using sediment curtains and other readily available technologies; avoid releases of gas, oil, diesel from construction equipment into waters adjacent to the project site
Temporary disruption of animal migrations, breeding, nesting	time restoration actions to avoid periods when sensitive life history stages are present
Short-term disturbance of existing plant communities	minimize/avoid impacts by saving & replanting native plant species
Temporary disturbance of ecological processes [c]	minimize impacts by minimizing duration of construction
Increased probability of long-term disease impacts	minimize disease by maintaining clean facilities and routinely monitoring organism health
Long-term organic enrichment of bottom substrates	minimize/avoid impacts through careful siting of project in areas with appropriate tidal flushing, currents
Long-term disturbance of animal and plant communities	minimize/avoid impacts through careful project siting
Increased probability of long-term competition, predation, and genetic interactions.	time releases of fish and choose appropriate species and/or stocks to minimize potential for genetic interactions, competition, predation

(a) clearing, grubbing, earth moving, dredging, burning, storing and transporting soil and sediment
(b) increased sedimentation, turbidity
(c) detrital export, nutrient flux, primary production

- best reduces fragmentation of the landscape and promotes adaptive management to apply knowledge gained from restoration projects to refine existing projects and to plan subsequent restoration; and

- provides the opportunity to use acquisition of the equivalent natural resources and services for the duration of the period of time that the habitat is maturing.

A report by the National Research Council on Restoration of Aquatic Ecosystems (NRC, 1992, p. 347-348) concluded that,

> "Wherever possible. . .restoration of aquatic resources. . . should not be made on a small-scale, short-term site-by-site basis, but should instead be made to promote the long-term sustainability of all aquatic resources in the landscape."

The Integrated Approach is the alternative that best fosters integrated aquatic ecosystem restoration at the landscape scale and therefore has been identified as the preferred alternative.

4.6 Cumulative Impacts of the Action Alternatives

The fact that this is a programmatic EIS with no specific projects or sites identified necessitates a general, program-level approach to evaluating cumulative impacts. The rationale for such discussion is such that the programmatic EIS is an analysis of cumulative impacts of a broad-based program or policy from which specific actions may be tiered. With respect to the action alternatives, the impacts are similar in nature and therefore discussed simultaneously. Again, the analysis is limited to other programs and projects that have a reasonable likelihood of interacting with the proposed program in terms of environmental effects. Other programs and projects considered in the cumulative impact assessment include remediation and habitat mitigation projects in the immediate Commencement Bay area (addressed in the Restoration Plan), unspecified other habitat restoration/enhancement/mitigation projects in the expanded study area, and various commercial, residential and industrial development projects in the study area. Examples of development projects that could interact with the NRDA restoration program in terms of environmental impact include: the Port of Tacoma redevelopment projects such as the widening and berth development in the Blair Waterway, and the filling and intermodal yard development in Milwaukee Waterway; City of Tacoma plans for development in the Thea Foss Waterway; SR-509 improvements and removal of Blair Bridge; SR-167 improvements; and commercial or warehouse projects such as the North Puyallup Fred Meyer store at the eastern end of the primary study area. Natural restoration projects would tend to compete with development projects for clean, vacant property.

In general, the proposed restoration programs would have beneficial cumulative affects with other remediation and habitat enhancement projects, and would tend to counteract the adverse impacts on habitat and related natural resources from commercial and industrial development projects. The potential for cumulative short-term construction impacts which are localized is limited by the potential for the projects under consideration to overlap in time and space. The beneficial affects of habitat restoration are less localized and temporary and so have more potential for cumulative impacts. One of the principal goals of the CB/NRDA restoration program is to implement projects that interact with one another (and with restoration projects under other programs) in a landscape ecology framework to maximize overall ecological benefits.

Indirect impacts that may occur under the action alternatives could be loss of important habitat for a particular species or group of species, or loss of, or changes to, a habitat which interacts with or supports another critical habitat for a population. For example, restoring one habitat may have an effect on adjoining habitats, which could either be beneficial or detrimental for a particular species.

Restoration projects are designed to restore or enhance lost or degraded habitat functions and to reduce the fragmentation of habitat areas. The projects are expected to restore ecological functions among the habitats throughout the areas, so that overall impacts should be beneficial to species which use these habitats. Projects proposed under the action alternatives, and other projects occurring in the area, would be coordinated in order to avoid cumulative adverse impacts to ecological processes and interactions among populations in habitats occurring in the area.

For the most part, cumulative impacts associated with any action alternative and other restoration/enhancement/mitigation projects would be beneficial to the fish and invertebrate populations occurring in the primary and expanded study areas. Any negative impacts have been discussed previously in this chapter.

There are no anticipated additional indirect impacts to *wildlife* other than those described in the previous sections. There is potential for both beneficial and adverse cumulative impacts to wildlife resulting from restoration and enhancement activities conducted under any action alternative plan (e.g., converting upland to wetland) and other projects occurring in the vicinity of the primary and expanded study areas.

It is anticipated that restoration under the action alternatives generally would benefit threatened and endangered species by increasing foraging habitat, providing habitat for injured natural resources and services, and creating additional habitat. It is anticipated that cumulative impacts to *endangered, threatened and/or sensitive species* would not occur. Indirect impacts other than those mentioned previously are not anticipated.

Should areas transformed from upland sites to *wetlands*, soils would then be classified as wetland soils at those sites. Such a transformation would influence future uses of immediately adjacent lands. Other indirect and cumulative impacts have been mentioned previously.

Restoration activities need to be coordinated in order to avoid creating counterproductive results. For example, the restoration action of creating fish spawning and rearing habitats in the mainstream or off-channel areas needs to be balanced by other upstream and downstream modifications to the riverine environment. Adding gravel to a stream for spawning habitat would be coordinated with upstream and adjacent activities to avoid creating an environment that will be overwhelmed by silt or sand *sedimentation* which can infiltrate gravel. Proposals to add gravel would be analyzed for potential impacts on water elevations. This applies also to restoration actions intended to enhance or modify habitat for fish, shellfish and wildlife, to avoid countering the effects of each other. In another example, building intertidal beaches should be performed so that future erosion or deposition of differing grain-sized sediment does not occur.

Localized activities which may create turbidity would be performed early in the restoration planning process; these activities include removing flow diversions, culverts or access, or restoring channel geometry. These activities should be completed before final habitat modification, such as creating fish spawning and rearing habitat, modifying the substrate, or seeding shellfish, are initiated.

Other projects that may occur in the study area or upstream areas could easily conflict with the goals of the action alternatives, and could cumulatively impact area resources. Because rivers may easily carry material a significant distance downstream, especially fine grained sediment, any project that affects the *hydraulic regime or transport of sediment* could negate the aim of restoration actions. Restoring instream flows and modifying groundwater or surface water hydraulics by creating wetlands could also have significant impacts to present and future users in the Basin.

A possible indirect impact to *water quality* as a result of restoration measures taken to improve conditions for a group of species, may be that water quality conditions acceptable for one group of species to flourish is not suitable for another group of species. Temperatures, flow rates, pH, dissolved oxygen concentrations, nutrients, and turbidity conditions may differ, particularly during spawning periods or at sensitive life stages. In order to minimize cumulative impacts related to various projects in the area, all projects would need to be well coordinated.

Anticipated indirect *air quality* impacts of restoration projects implemented under any action alternative are anticipated to result from vehicle emissions from employees driving to and from the project sites during construction activities and for post-construction maintenance and monitoring. Therefore, indirect emissions are anticipated to be a very small fraction of the total air shed contaminant burden during construction. Long-term indirect emissions are anticipated to be significantly less.

Cumulative air quality impacts from projects implemented under any action alternative approach would also be considered in the contaminant burden for the conformity analysis, which considers annual emissions. For example, if five restoration projects were conducted during a given year, the direct and indirect air emissions from all five projects would be included in the burden calculations to compare against the conformity thresholds for the criteria pollutants.

Cumulative long-term (residual) air quality is expected to improve from implementing any of the proposed restoration projects. Conversion of former industrial sites to productive mudflats, marshes and other enhanced habitat through earthwork, extensive plantings, and waterway design is not anticipated to contribute any increase in criteria pollutant emissions. Oxygen production may increase, and odors may shift from industrial to more subtle earthy, marsh-like or mudflat aromas.

Vehicular noise from employees driving to and from the project sites should be the only indirect *noise impacts* of restoration projects anticipated under any action alternative. Due to the limited size and short duration of construction projects envisioned, the vehicular commuting noise generated is anticipated to be negligible compared to the total volume of traffic currently carried by the road network in the study areas.

Because of the localized nature of the noise impacts, cumulative noise impacts can be more meaningfully considered once the project sites have been identified. Cumulative impacts could be anticipated where receptors may receive noise from two or more project sites, depending upon the distance of the receptors from the project sites. Mitigation of cumulative noise impacts would be best accomplished through sequencing or phasing the projects, ensuring that project construction is not occurring simultaneously on projects within close proximity to one another. Post-construction, long-term cumulative noise impacts might include an increase in noise from migrating or resident birds and constructed and/or enhanced waterways. These noises are not typically considered to be adverse impacts, and noise volumes are anticipated to be low.

Indirect impacts include those that may be attributed to the proposed action but are further removed in time or distance from the direct effects. Such impacts to land use and aesthetics are not anticipated to result from any of the action alternatives, particularly since no significant direct effects to this resource are anticipated.

Public access improvements could result in adverse habitat effects if such access is not controlled. Overuse of a restored site could result in habitat degradation from the human presence e.g., disturbance, noise, trampling of vegetation and soils, and discharge of waste. Public access to sites would have to be controlled, monitored and possibly modified to minimize such effects. The appropriate level of public access would vary by site type.

Careful coordinated design and monitoring should make cumulative environmental impacts insignificant, including those resulting from the incremental impact of the project. Other habitat restoration or environmental remediation projects, land development or redevelopment activities, and the local governmental plans or policies, would also be regulated by the same federal and state land planning and management regulations, it is unlikely that there would be adverse cumulative effects. Indeed, local ordinances, policies, and plans stress the importance of integrated efforts for the preservation and restoration of the area's vital natural resources. Therefore, there are no known actions, or current or future proposals, from which significant cumulative impact to land use or aesthetics could result in the study area.

To the extent that restoration sites interfere with the Tacoma Harbor Area, Washington State Department of Natural Resources believes there is a possibility that restoration activities could preclude commercial, industrial, and navigational uses of Commencement Bay. This would have a significant adverse impact on commerce in the Commencement Bay area if this were to occur. However, the Trustees believe restoration activities and commerce are not incompatible in Commencement Bay and have crafted all of the action alternatives to avoid adverse impacts to commerce. By carefully considering commercial, industrial, and navigational activities during site specific project planning, it is expected that any adverse impacts can be avoided.

Due to the fact that the potential for direct impacts upon *utilities and public services* from any of the discussed alternatives is small, any chance of additional substantive, direct, indirect, or cumulative impacts should also be remote.

Since none of the action alternatives are proposed to be conducted in areas designated for housing, direct, indirect, and cumulative impacts on *population and housing* should be negligible.

Since none of the action alternatives are proposed to be conducted in areas designated for transportation projects, no direct, indirect or cumulative impacts on *transportation* are expected.

Adverse cumulative impacts to cultural resources resulting from restoration activities should not occur. It is not the intention of the Trustees to disrupt cultural resources in the course of restoration. No adverse impacts are expected to result from implementing any of the action alternatives for the following reasons. The cost of mitigating for project impacts on cultural resources can be great. Due to the unique nature of prehistoric and historic sites and Native American traditional cultural values, it is essential to consider cultural resources during the site selection phase. If significant cultural or historical resources are affected by the proposed project, it will be necessary to coordinate and possibly mitigate actions prior to initiation of ground-disturbing activities. In some cases it may not be possible to mitigate for project impacts due to the unique nature or significance of a particular historical or cultural site. In those instances, the Trustees will abandon the site. Therefore implementing any of the action alternatives is not expected to contribute cumulatively to any adverse effects to cultural resources which may occur elsewhere within the study area.

4.7 Relationship Between Short-Term Use of Man's Environment and Maintenance and Enhancement of Long-Term Productivity

The proposed CB/NRDA restoration program is intended to restore, replace, rehabilitate, and/or acquire the equivalent of natural resources and services injured or lost as a result of the release of hazardous substances or the discharge of oil to the environment of Commencement Bay. The principal goal of the program is to achieve long-term enhancement of biological and natural resource productivity in the restoration area. The stated first goal of the Commencement Bay restoration planning process is to "provide a diversity of sustainable habitat types and species within the Commencement Bay ecosystem to enhance fish and wildlife resources." Therefore, the proposed program is expected to reduce the adverse effects of harmful short-term use of the environment, and to promote long-term productivity of the natural environment.

4.8 Probable Irretrievable and Irreversible Commitments of Resources

The proposed program does not entail any significant irretrievable or irreversible commitments of resources. Construction of some habitat projects may require importing materials such as rock, soil gravel and vegetation. Construction of structures may require other types of building materials, such as steel, wood, plastic, or concrete. Use of these materials is considered acceptable, however, considering the ecological benefit expected from the program. Many of these materials would not be committed irreversibly and could be used for other purposes later, although this seems unlikely to be desirable. The restoration projects would entail long-term commitment of land to habitat purposes, but this is considered environmentally beneficial and therefore consistent with the policy thrust of NEPA and the NRDA program.